

# Books

## Review

Fathi Habashi, *Chalcopyrite. Its chemistry and metallurgy*. New York, McGraw-Hill, 1978. 165 pp. R19.95.

The need for a single comprehensive reference work on chalcopyrite ( $\text{CuFeS}_2$ ) the most-important copper-bearing mineral, has been filled by this monograph.

The author reviews, in logical sequence, the large amount of literature available, generated chiefly during the past few years by research workers concerned with new and stricter environmental standards and consequently with the need for new methods for the extraction of copper from chalcopyrite.

The author deals with the occurrence of sphalerite, and its present method of treatment, its separation from other minerals by flotation, and its structure, physical properties, and thermal stability. The chemical properties of the mineral are reviewed with special reference to thermal oxidation, aqueous oxidation, reduction, and chlorination. Electrolytic anodic dissolution and cathodic reduction reactions are described, as well as the behaviour of trace and minor metals that fall into the category of valuable or nuisance byproducts, and the effect of these byproducts on smelting, electrolytic refining, and other processes. Numerous drawings and illustrations show the effect of several variables on the behaviour of the mineral. Finally, in two appendices a review is given of copper smelters in the world and their production capacities, and of *Gmelins Handbuch der Anorganischen Chemie*, the most comprehensive source of information on the chemistry and metallurgy of copper.

Comprehensive references are made to the literature on various aspects of the subject. The book will be of great assistance to research workers, mineral-processing engineers, mineralogists, geologists, chemists, and microbiologists. It will also fill a need at universities for teachers and students in all the various disciplines associated with the identification, recovery, geology, and mining of chalcopyrite.

D.A.V.

## Loss prevention and safety promotion

The Proceedings of the 2nd International Symposium on Loss Prevention and Safety Promotion in the Process Industries, Heidelberg, 6th to 9th September, 1977, are now available. The volume contains the opening lecture as well as the 57 contributed papers, which were presented in the following lecture groups: Software (11), Material properties and test methods (11), Process development, design, and construction (11), Vapour clouds (5), Hazard analysis (13), and Safety and fire protection (6). Also included are the discussions, the report on the Informal Discussion Meeting on Risk Analysis, and an authors' index.

The volume comprises approximately 630 pages including tables and figures. The price is DM80, plus postage and packing (DM7.50 surface mail; airmail on request).

Please address orders to DECHEMA, P.O.B. 97 01 46, D 6000 Frankfurt 97, West Germany.

## Chemical reaction engineering

The Proceedings of the 4th International/6th European Symposium on Chemical Reaction Engineering (4th ISCRE) held at Heidelberg, Federal Republic of Germany, from 6th to 8th April, 1976, are available from DECHEMA Deutsche Gesellschaft für Chemisches Apparatewesen, P.O.B. 970146, D-6000 Frankfurt/Main, West Germany, at the price of DM100 plus postage and packing.

The Symposium was sponsored by the European Federation of Chemical Engineering, the American Chemical Society, the American Institute of Chemical Engineers, and the Canadian Society for Chemical Engineering. It was organized by DECHEMA.

The papers are by authors from different European countries, and also from Canada, South Africa, the U.S.A., and the U.S.S.R. All the papers are in English. The volume consists of approximately 660 pages including tables and figures.

## Books received

*The Institution of Mechanical Engineers Proceedings Volume 190*. Copies obtainable from The Managing Editor, Books and Academic Journals, The Institution of Mechanical Engineers, Box 24, Northgate Avenue, Bury St Edmunds, Suffolk IP32 6BW. Price not given. Included are the papers presented in 1976.

*Tribos abstracts on friction lubrication wear*. Published by BHRA Fluid Engineering, Cranfield, Bedford MK 43 OAJ England. Price £30 (UK), US\$72 (Europe), US\$96 (Elsewhere). In order to meet the world-wide need for an authoritative abstracts journal in the field of tribology, BHRA introduced *Tribos* in 1968. Some 2000 abstracts are included annually dealing with all aspects of the technology such as bearings, lubricants, wear, and friction.

*Seawater corrosion handbook*, edited by M. M. Schumaker. Noyes Data Corporation Publicity Department, Mill Road at Grand Ave., Park Ridge, NJ 07656. 494 pp. A4. Illus. Cloth \$36. A practical book based on studies by U.S. Naval Research Laboratories that deal with corrosion in marine environments, at various depths, the effects of microorganisms and deterioration of non-metallic materials immersed or in contact with seawater. An annotated bibliography referring to the corrosion of metals is included.

*Department of Mines annual report 1977, Western Australia*. Government Printer, Perth, Australia.

*Australian mineral industry quarterly* 31(1) 1978 and 31(2) 1978. Bureau of Mineral Resources, Geology and Geophysics, Box 378, Canberra City, ACT 2601 Australia. Subscriptions \$8, individual number \$2. Mineral and fuel commodities in Australia are reviewed, and statistics of production imports, and exports are recorded.

*Financial Times mining international year book 1979*, edited by William G. Nightingale. 713 pp. The Financial Times Business Publishing Division, Minster House, Arthur St, London EC4R 9AX.

# NIM reports

The following reports are available free of charge from the National Institute for Metallurgy, Private Bag X3015, Randburg, 2125 South Africa.

## Report no. 1996

*The extraction of gold from chloride solutions.* (10th Nov., 1978).

Although most of the gold produced is the result of cyanide processing, there are a number of applications in which gold is produced from chloride solutions. Such processes include the refining of platinum, the processing of anode slimes, and the Wohlwill electrorefining process for the production of gold. The metal is conventionally recovered from such solutions after it has been reduced to metallic form with a selective reducing agent such as sulphur dioxide.

Ion-exchange and solvent-extraction techniques have been proposed for the production of high-purity gold from impure solutions. Of these, the XAD-7 resin system and the dibutyl 'Carbitol' (DBC) system used by the International Nickel Company have been described in the literature. Although the DBC system appears to be the better of the two in terms of the quality of the gold produced, it is not ideal with respect to cost, availability, and high soluble loss.

A new extractant for gold, isodecanol, is described that has none of these disadvantages. As shown in countercurrent laboratory tests, isodecanol is a satisfactory extractant both from a gold-rich solution (gold approximately 50 to 150 g/l) and from platinum process solutions.

Gold of a purity between 99,99 and 99,999 per cent can be produced by means of this system from solutions that contain very little gold and high concentrations of other metals.

## Report no. 1898

*Batch and pilot-plant tests on Merensky Reef ore from the Western Platinum Mine.* (8th Jun., 1977; reissued 30th Jan., 1979).

Laboratory bench-scale tests showed that slight improvements to the metal recovery could be obtained when sulphur dioxide or sodium carbonate was used in the flotation circuit. However, sulphur dioxide gave no improvement when tested on the pilot plant other than that it made the nickel mineral float faster. Regrinding and flotation of the coarse fraction of the scavenger tailing reduce significantly the content of precious metal in the final tailing, but exactly to what extent still remains to be determined by further work. Magnetic and gravity separation of the tailings did not improve the recovery of precious metal.

## Report no. 1920

*A mineralogical investigation of Mamatwan and Wessels manganese ores.* (15th Sep., 1977; reissued 3rd Jan., 1979).

A mineralogical investigation was made of the ores from the Mamatwan and Wessels mines of the Kalahari

manganese field to establish whether the Mamatwan samples could be upgraded to produce material with a lower content of calcium and a higher content of manganese. The study was followed by an attempt to remove the iron component of the Wessels ore.

It was concluded that heavy-medium separation was the most promising method of treatment for Mamatwan ore but that further tests should be undertaken, together with detailed sampling of the ore-body.

The sponsor is to conduct further tests on photometric sorting for possible use on Wessels ore.

## Report no. 1978

*The preparation and certification of a reference sample of magnetite ore.* (22nd Dec., 1978).

The preparation of a sample of magnetite to serve as a reference material is described, and the procedures used for the assessment of the homogeneity of the sample are outlined. Statistical analysis of the data submitted by 36 laboratories that resulted in the certification of the sample is presented. The certified values are as follows:

Al	0,41%	Na	91 p.p.m.
Ca	0,78%	Ni	281 p.p.m.
Co	223 p.p.m.	P	477 p.p.m.
Cr	21 p.p.m.	Pb	25 p.p.m.
Cu	502 p.p.m.	S	695 p.p.m.
Fe	66,6 <sub>3</sub> %	Si	0,16%
K	108 p.p.m.	Ti	0,43%
Mg	1,69%	V	520 p.p.m.
Mn	0,17%	Zn	142 p.p.m.

Provisional values are given for arsenic and cadmium.

## Report no. 1998

*Electrode response to the addition of zinc during the cementation of gold.* (25th Jan., 1979).

Control of the amount of zinc dust fed to emulsifiers on gold-reduction plants is an important goal with economic advantages. This report summarizes an attempt to meet that goal by the use of electrochemical probes for on-line process analyses and a feeding system for zinc slurry that can be automatically controlled.

The simple probe systems tested did not give predictable results and are therefore not industrially viable. The feeder system that is described worked well mechanically, and could be a useful adjunct to a plant once the principle has been established in practice.

## Report no. 2002

*The spectrochemical determination of phosphorus, magnesium, and iron in phosphate rocks and sulphuric acid leach liquors.* (26th January, 1979).

A description is given of a direct-reading spectrochemical procedure using an induction-coupled plasma source in the analysis of phosphate rocks and sulphuric acid leach liquors.

The phosphate rocks are digested in concentrated hydrochloric, perchloric, and hydrofluoric acids, and are

dissolved finally in hydrochloric acid. Scandium is added as the internal standard, and the solution is made up to a fixed volume. For the leach liquors, an aliquot portion is transferred to a volumetric flask, scandium is added as the internal standard, the content of sulphuric acid is adjusted to give a final concentration of 5 per cent (v/v), and the solution is made up to volume. The solution is then introduced into the plasma source, the exposure time being related to a predetermined number of counts for the internal-standard line. The relative standard deviation of the method for phosphorus and magnesium is 0,62 and 0,87 per cent respectively.

#### Report no. 1992

*The use of emission spectrometry for the determination of impurities in metals.* (24th Jan., 1979).

A method is described for the separation of a number of impurities in high-purity Co, Mn, and Ni, and for their determination by emission spectrometry using the induction-coupled plasma torch. The metals are dissolved in hydrochloric acid, and the elements are extracted into organic solvents with various chelating agents. The organic extracts, to which scandium and gold are added as internal standards, are excited direct in an induction-coupled plasma excitation source. The elements determined are Ag, Al, Be, Bi, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Sn, Ti, V, and Zr. The relative standard deviation ranges from 2,3 to 26,2 per cent over a concentration range of 0,6 mg.g<sup>-1</sup> to 0,003 mg.g<sup>-1</sup> in the sample.

#### Report no. 2003

*An electrodeless conductivity meter of improved sensitivity and reliability.* (28th Feb., 1979).

The report describes an electrodeless conductivity meter that uses coherent detection as the technique of signal extraction. Its minimum full-scale range is 50  $\mu$ S and its maximum full-scale range is set at 10 mS, but this can be increased to 1 S by internal adjustment. The device is completely temperature compensated, and the probes can be situated up to 200 metres away.

#### Report no. 2005

*The spectrometric analysis of manganese-bearing materials with particular reference to ferromanganese slags and metals.* (16th Mar., 1979).

A direct-reading spectrochemical procedure using an induction-coupled plasma source is proposed for the analysis of ferromanganese slags and metals.

The sample is fused with sodium peroxide, the fusion is dissolved in nitric acid, a fixed amount of scandium is added as the internal-standard, and the solution is made up to volume. The solution is then introduced into the plasma source, the integration time being related to a predetermined number of counts for the internal-standard line. The spectrometer is calibrated with synthetic solutions matched to the acid and sodium contents of the sample solutions. The precision (relative standard deviation) ranges from 0,01 to 0,02 for all the elements measured. The elements determined (expressed as their oxides) are iron, silicon, aluminium, calcium, magnesium, manganese, and titanium.

#### Report no. 2006

*An examination of procedures for the analysis of dry powders by atomic-absorption spectrophotometry.* (28th Feb., 1979).

An account is given of an assessment of atomization and measurement procedures for the analysis of elements in dry samples of powdered ore. Two atomization procedures were studied: that using an air-acetylene flame, and that using electrical-resistance heating. The former procedure was found to be the more satisfactory, and resulted in reasonably good accuracy and precision in the determination of silver, bismuth, and cadmium at levels between 0,1 and 40  $\mu$ g/g in a number of sample materials having widely differing matrices.

#### Report no. 2007

*The instrumentation and computerization of a 25 MV. A submerged-arc furnace.* (25th Mar., 1977; reissued 16th Mar., 1979).

This report describes the installation of a process computer on a 25 MV. A charge-chrome furnace at the plant of The Southern Cross Steel Co. (Pty) Ltd, Middelburg. At the close of the project, the computer was logging the furnace and certain control functions were being included. The aims of the project and its relation to a previous project are also described.

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## Corrosion

The International Corrosion Council has decided to hold the next International Congress on Corrosion in Mainz, Federal Republic of Germany, from 6th to 11th September, 1981. DECHEMA Deutsche Gesellschaft für Chemisches Apparatewesen, Frankfurt/Main, will be responsible for the organization. As the title (8th International Congress on Corrosion) indicates, the Congress is

not restricted to metallic corrosion and protection.

The Congress will be held in conjunction with the 7th European Congress on Corrosion. The event will be sponsored by the European Federation of Corrosion.

Enquiries should be directed to DECHEMA Deutsche Gesellschaft für Chemisches Apparatewesen, P.O.B. 970146, D-6000 Frankfurt/Main, West Germany.

## Process control

The First European Symposium on Real-time Data-handling and Process Control will be held in West Berlin from 23rd to 25th October, 1979.

The aims of the Symposium are to promote the development and use of common practices in real-time datahandling and process control, to confront users and designers with existing common techniques and methods, and to provide a forum for the exchange of views on improving the interchangeability and interconnection of hardware and software. This will be achieved by:

- reviewing different applications of realtime data-handling and process control
- identifying common practices in both hardware and software
- identifying design principles that facilitate the transfer of technology between fields of application
- reviewing existing common standards and proposals and discussing their relevance and benefit to European realtime datahandling and process control applications
- considering long-term requirements.

Further details are available from Realtime Data 79, Congress Organization Company — Kongres-Zentrale, John-Foster-Dulles-Allee 10, D-1000 Berlin 21, West Germany.

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## Geomechanics

The 28th Geomechanics Colloquy, organized by the Oosterreichische Gesellschaft für Geomechanik, is to be held at Salzburg on 18th and 19th October, 1979.

The topics for discussion are as follows:

The Functions of Engineering Geology in Rock Constructions

Earthquakes — Failures on Constructions and Pre-

vention of Damages

Mechanization in Tunnel Driving

Sharing the Risks in Rock Engineering.

The official languages will be English and German, with simultaneous translation.

Further information is obtainable from the Gesellschaft at 5020 Salzburg/Austria, Paracelsusstrasse 2.

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## Geostatistics

A short course on 'Geostatistics for exploration and production planning' is being conducted by the Applied Earth Sciences Department, Stanford University, California, from 27th to 31st August, 1979. The instructor will be Dr Andre G. Journel.

For further information, contact Rita Hoffmann, Coordinator of the Short Course, Applied Earth Sciences Department, Stanford University, Stanford, California 94305, U.S.A.

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## Business administration

The Twelfth Executive Development Programme of the Graduate School of Business Administration, University of the Witwatersrand, is to be held from 9th July to 17th August, 1979.

The Wits. Executive Development Programme is held specifically in mid-year, when overseas universities are in recess and some of their most prominent lecturers can be selected to teach on the Programme. Their experience, gathered over years of business consulting and teaching on international executive courses, provides the Programme with an expertise comparable with any of its kind in Europe and the United States. The School's permanent staff and specialist lecturers provide the background pertaining to South African conditions.

Designed to assist South African companies with their need to update and broaden their managerial competence, the Programme is revised annually to meet the

current demands of the changing economic environment.

The programme for 1979 has been condensed to a six-week period. The number of lectures and contact hours per day will be increased so that it remains the same as in previous programmes, but the presentation time has been reduced for the benefit of sponsoring companies.

Candidates do not require a university degree. However, they do require managerial experience, and should have attained a level of significant responsibility within their company of employment. The Programme exposes participants to concepts of management that provide a breadth of perspective and analytical attitudes towards the management process.

Further information is obtainable from Mrs C. Morris, Liaison Officer, Graduate School of Business Administration, University of the Witwatersrand, P.O. Box 31170, 2017 Braamfontein. (Telephone 642-4771.)

## The engineer and the law

A series of four meetings on the above subject is being conducted by the Measurement, Computation and Control Sub-Committee of The South African Institute of Electrical Engineers.

The topics being covered are as follows:

The Professional Engineer

The Factories Act

Labour Legislation

Patents

Insurance

General Law of Contracts

The Engineer Overseas.

The meetings are held in the auditorium of the Escom

Head Office at Megawatt Park, commencing at 17h30 and finishing at 19h30 on each evening with a break for refreshments (at about R1,50 per head) from 18h15 to 18h45.

The meetings are open to engineers of all disciplines, whether they be Electrical, Mechanical, Civil, Chemical, Agricultural, or Mining and Metallurgical. Final-year students in engineering and law are also welcome to attend.

The last three meetings in the series are being held on 5th June, 3rd July, and 7th August, 1979. For supper arrangements, contact The Secretary, SAIEE, P.O. Box 61019, Marshalltown, 2108.

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## Lead smelter for South Africa?

The National Institute for Metallurgy and Gold Fields of South Africa are making a comprehensive joint investigation of the technical and economic viability of an integrated lead smelter. Under consideration is the erection of a smelter for the annual production of 30 000 tons of lead from residues of South African origin. In times of high demand for lead metal, the residues, which are now being stockpiled, would be supplemented by concentrates produced at a lead mine.

A lead smelter of the capacity envisaged would ensure South Africa's self sufficiency in all the vital base metals

(copper, tin, and zinc are already being produced in sufficient quantity).

Companies in the Gold Fields Group already produce two of the base metals: Zincor produces 75 000 tons of zinc a year at its electrolytic refinery at Springs, and Rooiberg, in the northern Transvaal, will be supplementing other local production of tin when its new smelter, with a capacity of 2000 tons per annum, has been fully commissioned. South Africa's annual production of copper now totals 170 000 tons from three smelters.

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## Conference on titanium

The Fourth International Conference on Titanium will be held from 19th to 22nd May, 1980, in Kyoto, Japan. The International Conference is organized by the Japan Institute of Metals in association with the Metallurgical Society of AIME, American Society for Metals, the Metals Society (London), the Academy of Sciences of the USSR, Deutsch Gesellschaft für Metallkunde, and Société Française Métallurgie.

The conference will cover all aspects of the science, technology, and application of titanium-base materials from extraction to ultimate utilization, and is intended to attract titanium users as well as scientists and technologists working in the field of titanium metallurgy. Emphasis will be placed on recent research and development in laboratories and plants all over the world.

The themes include:

1. Extractive metallurgy.
2. Primary and secondary fabrication methods for melting, ingot conversion, metalworking, forming, brazing, diffusion bonding, protective coatings, etc.
3. Specification test methods, mechanisms of possible failure modes, non-destructive inspection, and other quality assurance approaches.
4. Crystallography, physical and thermodynamic pro-

perties, local order, phase stability, and phase equilibrium.

5. Plastic deformation and fracture studies, superplasticity.
6. Phase transformation including martensitic, nucleation and growth, transition phase, morphology of precipitates, heat treatment of alloys.
7. Development of new titanium alloys for use from cryogenic to high temperatures.
8. Application of titanium in airframes for aircraft and spacecraft, gas turbines, pressure vessels, marine, chemical equipment, etc.
9. Titanium matrix composites.
10. Environmental effects, such as chemical, variable loading, fretting, etc. on the behaviour of titanium alloys.
11. Effect of titanium as an additive on the properties of non-titanium base alloys.
12. Standards for titanium and titanium alloy products.
13. Titanium castings.

All correspondence should be addressed to the Conference Secretariat, 4th International Conference on Titanium, The Japan Institute of Metals, Aoba Aramaki, Sendai 980, Japan.