

The flowrates of pregnant solution were increased from 4,823 kl/min in 1971 to about 5500 kl/min in 1981. This increase in flowrate also had an effect on the losses of organic solvent and was mainly responsible for the lower losses for a corresponding content of suspended solids.

The simplicity of the clarifier makes it easy to operate at very low cost.

The addition of non-ionic polyelectrolyte to the uranium pregnant solution has no effect on the phase separation in the extraction mixer-settlers on the Purlex plant provided that the addition rate is controlled to less than 1 p.p.m.

Acknowledgements

The author thanks the Management of Buffelsfontein Gold Mining Company Limited for permission to publish the paper, and also the staff of Metallurgical Services who were involved during various stages of this project.

Reference

MOUCHET, P., and PULL, A. Complementary treatments of liquors after leaching. Applications of sludge contact clarification. Presented at Hydrometallurgy 81, a symposium held at the University of Manchester in 1981.

Book News

I. New books

● *Specialty steels and hard materials*, edited by N. R. Comins and J. B. Clark. Oxford, Pergamon, 1983. 482 pp. Hardcover £55.50.

This volume consists of the Proceedings of the International Conference 'Materials Development '82', which was held in Pretoria from 9th to 12th November, 1982. The 49 papers give an in-depth treatment of the fundamental physical concepts involved in the development and characterization of specialty steels and hard materials. Particular attention is paid to structure-property relationships to strengthen the link between the understanding of microstructural detail, alloy design, and processing technology and applications, including aspects of economic viability. The papers on specialty steels include discussion of high-strength low-alloy steels, stainless steels, maraging steels, high-speed steels, and rapid-solidification processing, as well as consideration of the roles of specific alloying elements. An equally large variety of topics is covered in the hard-materials section with papers covering tungsten carbide-cobalt hard metals, non-oxide ceramics, CVD processed hard materials and coatings, synthesis of diamonds, and sintered polycrystalline ultra-hard materials.

● *Papers presented at an international conference on advances in flow measurement techniques*, edited by H. S. Stephens and B. Jarvis. BHRA Fluid Engineering (Cranfield, Bedford, MK43 OAJ, England), 1982. £36.

This volume includes the 27 papers presented at a conference that was held in Warwick, England, from 9th to 11th September, 1981.

● *Papers presented at Fourth European Conference on Mixing*, edited by H. S. Stephens and D. Goodes. BHRA Fluid Engineering (Cranfield, Bedford, MK43 OAJ, England), 1982. £36.

This volume includes the 29 papers presented at the above conference, which was held at Noordwijkerhout, Netherlands, from 27th to 29th April, 1982.

● *Papers presented at an international conference on hydrocyclones*, edited by H. S. Stephens and G. Priestley. BHRA Fluid Engineering (Cranfield, Bedford, MK43, OAJ, England), 1982. 248 pp. £27.

This volume contains the 16 papers that were presented at a conference that was held in Cambridge, England, in October 1980.

● *Controlled atmospheres for heat treatment*, by R. Nemenyi. Oxford, Pergamon, 1983. 225 pp. Hardcover £20, flexicover £7.50.

This book, which is in the Pergamon *Materials Engineering Practice* series, presents a comprehensive coverage of the basic principles, techniques, and equipment used for heat treatment. It describes the interaction between metals and gas atmospheres, the purpose of heat treatment in protective atmospheres, the most important types of atmosphere and equipment, and different types of furnace. It also covers the inert gas atmosphere, vacuum as the protective atmosphere, and the methods and equipment used for atmosphere control. Health and safety aspects and methods of accident prevention are described in detail. It presents a comprehensive coverage of the basic principles, techniques, and equipment used for heat treatment.

● *Electrochemical techniques in corrosion testing and research*, edited by J. S. Scully. Oxford, Pergamon, 1983. 150 pp. Flexicover £9.45

This volume includes selected papers from the meeting held in Manchester from 4th to 6th January, 1982, and is published as a special issue of *Corrosion Science*, volume

23, number 4, being supplied to subscribers as part of their subscriptions. It contains 11 papers that discuss many of the latest issues and developments in the field, and is of value to materials scientists, metallurgists, physicists, and chemists.

2. Book reviews

● *Off highway truck haulage*, by the Newman Combined Group. Parkville (Victoria), Australasian Institute of Mining and Metallurgy, 1982.

Reviewer: B. J. Vorster

The publication covers the complete spectrum of haulroad construction and maintenance, truck maintenance, and tyre management and maintenance, as well as new developments in off-highway trucking. The 16 reviews presented have been skilfully compiled by the different authors and provide valuable information.

The first three reviews provide the reader with an in-depth knowledge of haulroad construction and maintenance based on practical mining experience. The second section (papers 4 to 12), based on practical mining experience in a wide field of truck maintenance (structural, mechanical, electrical, tyre management, and planning), covers the spectrum on a professional and highly technical level. Of prime interest in the final section, which deals with the latest developments in trucks and engines, is a discussion on the development of the Komatsu 150 t haultruck and a comparison with the diesel-electric drive system.

These reviews provide valuable information on a highly technical level about off-highway truck haulage in open-cast mining. However, this reviewer feels that more emphasis could have been placed on the latest developments in drive systems, tyres, and engines for trucks above 150 t since the acquisition of larger trucks should be given serious consideration when purchases are made or a mine is being designed.

● *Elsevier's mineral and rock table*, compiled by P. Lof.

Reviewer: A. Wedepohl

Copies of the 135 × 83 cm (53 × 34 inch) chart published by Elsevier Scientific Publishing Co. can be ordered from that company at

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Where one copy only is required, it must be ordered from Holland (price: D.Fl. 30,00). At the time of writing, the exchange rate is 2,4420 D.Fl to the rand and 0,914 dollar to the rand.

A large portion of the chart consists of high-quality coloured photomicrographs of 124 well-known minerals, 74 being rock-forming minerals and 50 ore minerals. The minerals are divided into groups having specific optical properties. Except where irrelevant, all the photo-

micrographs of the minerals were taken in plane polarized light as well as with crossed nicols. All the information on optical characteristics is given, including any peculiarities that would assist in identification. Additional information such as habit and, in the case of ore minerals, Vickers hardness is also included. Complementary to these coloured photomicrographs, the much-used Michel-Levy chart of interference colours is reproduced in the lower section of the chart.

Much of the lower section of the chart consists of diagrams and tables used in the classification of igneous, metamorphic, and sedimentary rocks. Included among the sedimentary rocks are some unusual groups such as phosphorites ($P_2O_5 > 18$ per cent) and, welcome additions, a diagram classifying carbonaceous rocks and tables defining coal types, macerals, etc.

The information on ores includes a P-T diagram of ore deposit facies, a table of ore associations, and diagrams of intergrowth patterns with information on the minerals for which they are typical and on the ease of liberation for various types of intergrowths.

Other items of interest are a table of meteorite classification, a P-T diagram of upper mantle facies, diagrams for use in the estimation of volume percentages and age relations, and illustrations of migmatite textures.

To assist in the use of the chart is a mineral and rock index, indicating the position on the chart where one would find particulars of each of these.

As indicated above, the chart contains a wealth of information. It would be an excellent learning aid for students of geology from the second year upwards, as well as being a useful and concise reminder for persons already working in the fields of mineralogy and petrology. It would also be of interest to those working in related fields such as ore-dressing, extraction metallurgy, and mining engineering.

The price seems reasonable for what is a well thought out, well presented, and very informative chart.

● *Field geologists' manual*, by B. A. Berkman. *Mono-graph Series No. 9*, Australasian Institute of Mining and Metallurgy, 1982. 295 pp.

Reviewer: R. A. G. Cuipers

This book is exactly what it is called, being a reference work that most geologists and mining engineers, whether in Australia or not, will welcome. It consists of 295 pages of tables, nomograms, formulae, graphs, and a text that is to the point and not over-expansive. The author assumes a standard of training or scholarship, and has attempted to abstract the critical parts of a reference library consisting mostly of the basic material that may be required by a geologist during field projects, where access to a library is not always possible.

Some of the material is of no use to anyone outside Australia. However, this applies to a very small percentage of a book with chapters on mineral and rock formation, geochemistry, mining and economic geology, geological mapping and geometric survey data, engineering geology, geohydrology, geophysics, and drilling. Mathematical tables and conversion factors form the last chapter of the manual, and will be welcomed by every explorationist as a part of his field kit.

3. Mintek reports

The following reports are available free of charge from Mintek, Private Bag X3015, Randburg, 2125, South Africa.

● Report M56

A computer programme for the evaluation of process routes in the production of ferrochromium.

An interactive computer programme, 'ROUTES', has been written to simulate process routes for the production of ferrochromium from the drying of the raw materials to the production of the final alloy. Steady-state material and energy balances were used in the solution of a series of simultaneous equations derived from the specifications for the process and performance of the equipment. The rates of reaction, and hence the size of the equipment, were not considered, and a 'black-box' approach was used throughout. The programme can be used to generate a complete flowsheet for any process with up to ten pretreatment stages and up to two smelting stages. In the derivation of the structure of the programme, an important consideration was recycling of the gaseous products of the reaction to minimize the electrical energy consumed by the smelting furnace.

In tests carried out on the programme, real processes were simulated, and the results obtained were compared with the published operating data for the respective processes. It was found that, in all cases where a direct comparison could be made, the programme gave consistent and realistic results, which indicates that the programme must be relatively accurate. The evaluation of a process route based on plasma smelting and prereduction in a fluidized bed demonstrated that considerable research work is required on the use of a fluidized bed if the potential benefits of this route are to be realized.

The programme can be used in its present form to simulate the production of iron by direct reduction and of silicon alloys by suppression of the chromium content of the ores, but a new programme (based on a similar structure) would have to be written to simulate process routes for the production of ferromanganese.

● Report M61

An atomic-absorption programme for the Apple II Plus computer.

An interactive computer programme, the AA-PROGRAM APPLE, has been designed and written to process data obtained during routine analysis by atomic-absorption spectrophotometry.

The programme is fast, convenient for the user, and was found to perform satisfactorily during routine operation in the laboratory. The computer used is an Apple II Plus with a video screen, and the language of the programme is Applesoft BASIC.

Operating instructions for the computer and a print-out of the programme are given in the Appendices.

● Report M63

A general-purpose data logger.

The Council for Mineral Technology has developed a data-logging system for mineral-processing plants. The

specifications of the data logger are contained in this report, which explains how users can interface the system to a plant and programme the data-logging options that best suit their particular needs. Several output displays are available and allow the user to watch on-line plant behaviour. Information describing plant performance is stored on cassette tape at regular intervals, and the tape format enables stored data to be transferred to other computer systems for additional analysis.

● Report M65

A preliminary survey of the corrosivity of water in gold mines.

Samples of water that had been collected underground from eight South African gold mines were subjected to comprehensive analysis of the quality of the waters, and their corrosivity on mild steel was measured by the laboratory techniques of extrapolation from Tafel plots and of polarization resistance.

The results indicate that, if certain qualities, such as pH, Langelier index, and degree of aeration, are beyond certain specified limits, the corrosive effect of the water is affected. The applicability of the corrosivity index in predictions of the degree of corrosion is questioned, and alternatives are postulated. Suggestions are included for future work involving the fundamental characterization of the corrosivity of mine waters.

● Report M66

A review of corrosion inhibitors: theory and practice.

The chemical water treatments available to the mining industry are diverse in composition, action, and efficiency. This review illustrates the mechanisms and uses of inhibitors for the prevention of corrosion over the whole range of aqueous systems. It should provide an understanding of the problems associated with the choice of inhibitors for use in plants.

● Report M67

The determination of total cyanide in solutions containing uranium and gold.

This report gives the results of a limited investigation of three distillation procedures and their variants for the separation of cyanide. The spectrophotometric measurement, which follows the distillation, uses either a mixture of pyridine and pyrazolone, or a mixture of pyridine and barbituric acid.

It was found that the method published in the South African *Government Gazette* in 1969 gives quantitative recoveries from potassium cyanide solutions but not in the presence of gold. The ligand-displacement method did not give quantitative recoveries in the presence of gold, except when zinc was added to the distilland, and it then failed to give a quantitative recovery of cyanide from ferrocyanide. These two methods were therefore rejected as unsuitable for the determination of cyanide in solutions containing small amounts of uranium and gold.

The procedure of the American Public Health Association (APHA) was found to give quantitative

recoveries in the presence of gold, uranium, thiocyanate, and ferrocyanide when cuprous chloride, or cuprous chloride with magnesium chloride, was added to the distilland. The spectrophotometric measurement using a mixture of pyridine and barbituric acid is preferred. The calibration range of the method is 0,5 to 6 μg of cyanide, and the limit of determination is 0,04 $\mu\text{g}/\text{cm}^3$. (The relative standard deviation of the method is 0,05.) The distillation time in the method is approximately 2½ hours; with 3 distillation trains, up to 9 distillations can be made per day, plus a further 2 hours for the spectrophotometric determination.

The preferred laboratory method is detailed in an appendix.

● Report M68

The suitability of Doppler flowmeters for use in the minerals-processing industry.

In this report, six commercially available Doppler flowmeters, which were operated under conditions likely to be encountered in the minerals-processing industry, are evaluated. The effects of the density and particle-size distribution of a flowing slurry and the optimum siting of the flowmeter probe are considered, and the results of tests on the response and linearity of the flowmeters are reported.

● Report M70

The preparation and certification of two reference materials of South African manganese ore.

This report describes the preparation, analysis, and certification of two South African manganese ores for use as reference materials.

Approximately 300 kg of material from the Wessels Mine and 450 kg from the Mamatwan Mine were prepared. Recommended values were assigned for ten constituents of each of SARM 16 (the Wessels ore) and SARM 17 (the Mamatwan ore). In addition, four provisional values were assigned to each material.

Nineteen laboratories in seven countries, using a wide variety of analytical techniques, provided the analytical results.

● Report M78

An evaluation of the Leeds laboratory-scale flotation cell.

A laboratory-scale flotation cell designed by Professor C. Dell at the University of Leeds, England, was evaluated at Mintek. The cell was designed to achieve maximum reproducibility between tests by the control of as many process variables as possible, and to have a froth discharge that does not involve scraping by an operator. The cell was compared with a Denver laboratory flotation cell operated in two modes.

The Leeds cell gave the least variation between replicate tests, but initially it had a number of mechanical problems owing to its somewhat fragile design and construction. After being modified, it was used for over eighty flotation tests and performed satisfactorily. When an operator is familiar with the cell, it is relatively simple to use and gives reliable results.

● Report M79

The determination, by X-ray-fluorescence spectrometry, of gold and uranium on resin.

The problems encountered in the determination of gold and uranium that are present simultaneously in a sample of resin were considered, and new background positions, as well as correction factors for background lift and partial spectral overlap, were determined for use in the X-ray-fluorescence measurement of these elements.

The agreement between the results obtained by the use of the X-ray-fluorescence method and those obtained by atomic-absorption spectrophotometry were found to be satisfactory. The relative standard deviation in the former measurements is 0,005 at a concentration of 1000 p.p.m., and the working range of the calibrations is 15 to 1000 p.p.m. These limits can be extended by further dilution of the sample. The limits of determination are 6 p.p.m. in the briquette prepared from a sample of resin and 18 p.p.m. in the sample when the maximum mass of the sample is 3 g.

The procedure is intended primarily for use in the rapid determination of gold and uranium when no analysis for other elements are required. The time taken for the analysis is 2 hours for 10 samples when 6 standards are used.

A computer programme that was developed for the processing of the data is appended as part of a laboratory method.

● Report M80

The installation and commissioning of a Siemens SRS200 sequential X-ray-fluorescence spectrometer.

The operation of the Siemens SRS200 automatic X-ray spectrometer, which can also be operated manually, is described.

Details of its application to routine analysis are given, and these demonstrate its high level of performance, even in the analysis of elements present in part-per-million concentrations. Modifications that were made to the sample cups and the installation of a non-dedicated computer are discussed.

● Report M81

The application of the inductively coupled plasma system to the simultaneous determination of precious metals.

This report describes the development of a spectrochemical technique using excitation by an inductively coupled plasma (ICP) source for the simultaneous determination of the precious metals (defined here as gold, silver, and all the platinum-group metals except osmium) in a wide variety of samples from a plant for the extraction and refining of platinum metal.

The limits of detection for the analytes were determined in various acid and salt media and, under the conditions used, ranged from 20 to 100 ng/l.

The analytes were determined in the presence of a thousandfold excess of each of the other precious metals used as a matrix element. Some severe interferences were noted but were ascribed to spectral-line overlap or to contamination of the matrix material.

Various dissolution techniques, based upon standard procedures applied in the precious-metals industry, were used, depending on the particular type of material treated.

The spectrometer was calibrated by the use of solutions containing the analytes, sodium chloride, and acid, with scandium as the internal standard.

The accuracy and precision of the technique, established by the analysis of many samples of each type, were

found to be satisfactory when close attention was paid to detail in the preparation of the analytical solution. The relative standard deviation of the method ranges from 0,005 to 0,05, depending on the element being determined.

Open-pit and strip mines

The South African Institute of Mining and Metallurgy and the Mining Alumni Society of the University of Pretoria are organizing an International Conference on The Planning and Operation of Open Pit and Strip Mines in Pretoria from 9th to 13th April, 1984. Other Institutes co-sponsoring the Conference are The Canadian Institute of Mining and Metallurgy, The Institution of Mining and Metallurgy, and The Society of Mining Engineers of AIME.

Surface mining technology has advanced in parallel with the ever-increasing demands for higher productivity. In South Africa the latest technology is applied in surface mining, e.g. mobile in-pit crushers, trolley-assist haulage, trajectory blasting, and maintenance planning systems. The practical application of these and other techniques will be discussed at the Conference. Delegates will have the opportunity to visit mines where these techniques are applied.

This Conference will emphasize the practical aspects of the planning and operation of open-pit and strip mines. It is planned as an update to the last symposium held in South Africa on Planning Open Pit Mines, which took place in 1970. That symposium emphasized the theoretical aspects, specially slope stability.

The Conference should appeal to consulting engineers, mine management, mining engineers, mine planning engineers, maintenance engineers, manufacturers and suppliers of equipment, academic staff of universities, and members of research organizations.

Papers are invited that address any of the following aspects of open-pit and strip mining:

SECTION A: Open-pit and strip mine planning: exploration, mass sampling, technical and financial evaluations, feasibility studies, slope stability, planning techniques.

SECTION B: Operation of open-pit and strip mines: drilling, blasting, loading, transport, communications, management, quality control.

SECTION C: Selection and maintenance of equipment in open-pit and strip mines: preventative maintenance, maintenance facilities, equipment selection, replacement of equipment.

SECTION D: New methods and developments in open-pit and strip mines: mobile crushers, electrification of diesel equipment, future trends.

Prospective authors are asked to submit a synopsis of their paper not exceeding 300 words. This synopsis must reach the Conference Secretary before 2nd June, 1983.

A set of proceedings, including all papers and contributions, will be published after the Conference. Preprints will be available at the Conference.

There will be an indoor and outdoor exhibition of surface-mining equipment on display during the Conference.

Further information is available from Mrs Erika Esterhuyse, Conference Secretary, Open Pit and Strip Mining Conference, Department of Mining Engineering, University of Pretoria, Pretoria, 0002 South Africa. Telephone: (012) 437011. Telex: 30160 SA.