

Book News

1. Book reviews

● *Mill Operators' Conference*. Parkville (Australia), Australasian Institute of Mining and Metallurgy, 1982. 425 pp.

Reviewer: B. K. Loveday

This collection of 37 papers was presented at a symposium organized by the North West Queensland Branch of The Australasian Institute of Mining and Metallurgy in September 1982. As the title implies, it is aimed largely at the operators and designers of mineral-processing plants.

A number of papers were written by equipment suppliers, and give details of recent applications. Examples of these are the Morgensen sizer, Reichert spirals, Skega mill liners, conveyor idlers, Banana screens, mill selection (Allis Chalmers), large (Outokumpu) flotation cells, and the use of the Dow grinding aid. The paper on spirals describes an interesting variety of spiral cross-sections and design improvements.

Papers on plant developments include the use of Caro's acid for the leaching of uranium, two-stage classification at Bougainville, developments with crushers at Mount Isa, radiometric sorting of uranium ore, and optimization of coal washing.

A few research-oriented papers are interspersed, and include papers on the scale-up of ball mills, flotation of violarite, bin design, and flotation of fine coal.

● *Off highway truck haulage*. Newman Combined Group, the Australian Institute of Mining and Metallurgy and the Institute of Engineers in Australia. Sep. 1982.

Reviewer: B. J. Vorster

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

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), which is 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 truck and engine developments, is the discussion on the development of the Komatsu 150 t haultruck and its comparison with the diesel-electric drive system.

These reviews provide valuable information on off-highway truck haulage in open-cast mining. However, as the acquisition of such trucks should be given serious consideration when purchases are made or a mine is being designed, one feels that more emphasis could have been placed on the latest drive systems, tyres, and engine development of trucks above 150 t.

● *Environmental engineering in South African mines*. Johannesburg, Mine Ventilation Society of South Africa, 1982. 974 pp.

Reviewer: A. N. Brown

This textbook is most welcome because there has been a particular need for such a book in the South African mining industry. It is comprehensive, up-to-date, and well written; and for these reasons it is destined to become the Mine Environmental Engineer's 'Bible'. The book is a successor to *The Ventilation of South African Gold Mines*, which served the needs of the industry well over the past decade. However, the scope has now been expanded to cover all types of underground and surface-mining activity, including gold, coal, base-metal, and other mines. As such, its usefulness has been considerably extended beyond that of the earlier book, and because of this it is sure to appeal to mining engineers of the international mining community.

Underground mining in the Republic of South Africa is now more than a hundred years old, and in that time mining activity has progressed steadily from the grass roots down to depths of 4000 m below the surface. Severe problems have been encountered concerning heat, injurious dust, and toxic and explosive gases. It stands to the great credit of environmental and mining engineers that solutions to these problems have been found so as to produce environmental conditions that are acceptable. It is perhaps natural that some of the most capable and astute persons employed in the mining industry over the years should have addressed themselves to these problem areas. A vast amount of research and development work has been done, and a wealth of practical experience has been gained in every facet of the mining environment.

In the world generally, more attention is being given to environmental conditions today than ever before. An increase in the scope and degree of mechanization over the years, but more accelerated in recent times, has been a complicating factor. The past two decades have also seen tremendous technological developments with the coming of the electronic age. Such developments have had far-reaching effects on telemetry, mensuration, and sampling, while the availability of digital and analogue computers has led to new and better methods of analysis, simulation, and control.

This book is the combined effort of no fewer than 29 authors who are all specialists and authorities in their particular fields. The majority of them are drawn from the South African mining industry, while there are 3 contributors from overseas. The list of authors is indeed impressive, and the many publications that stand to their credit is indicative of their vast experience. It is noteworthy that the top men in environmental engineering of six major mining groups, as well as specialists from particular mines, are among the authors. In addition, authorities drawn from the two South African universities dealing with mining are included. Since the Chamber of Mines Research Organization was established in 1964, a great deal of attention has been directed towards research and development work concerning environmental conditions and human heat stress. The fact that eight of the authors are drawn from that body emphasizes the important role played by the Organization.

The work consists of 38 well-chosen chapters of easy-to-read text. The long lists of references that support many of the chapters attest to the depth of experience on which they are based. However, some chapters (notably that dealing with underground fires) have few references to published work, despite the existence of extensive reference material.

Fourteen chapters devote a great deal of attention to basic laws, fundamental concepts, and theory. They cover fluids and fluid flow, pressure-measuring instruments and pressure surveys, and the measurement of airflow, water flow, and compressed air. The aspects of basic fan engineering and ventilation network analysis are adequately dealt with. Comprehensive coverage of the important subject of heat is contained in chapters concerning elementary thermodynamics, thermodynamics of mine airflow, thermometry and temperature measurements, psychrometry, and heat transfer. Two rather useful chapters deal with statistics and an introduction to telemetering.

Seven chapters dealing with the quality of ventilating air discuss the properties and effects of dust, sampling of airborne particles, sources of mine dust and dust control, gases encountered in mines, the threshold limits of hazardous substances, explosible dusts, and radiation in mines.

The practical aspects of ventilation and cooling practices in mines are handled in eight chapters. These deal with the sources of heat, refrigeration theory and practice, reticulation of chilled water, main and auxiliary ventilation practice, economics of mine ventilation, and the planning of ventilation and refrigeration requirements.

The remaining nine chapters deal with important peripheral aspects of environmental engineering. They include two chapters dealing with the fundamentals of human heat stress and practical aspects including acclimatization practice. Two brief chapters concern the subject of underground fires in mines, the fires in coal mines being handled as a separate entity. Two chapters cover aspects that are traditionally associated with environmental control departments, namely, compressed air and water management, and a further two deal with aspects that concern illumination and noise in mines. Although the chapter on illumination is terse and basic, the subject is covered adequately. Finally, a chapter on surface air pollution, which is a welcome inclusion in the volume, deals with the measurement, sampling, and control of air pollution in the vicinity of mines and works.

There is no doubt that this textbook will find its greatest appeal in the field of education and training. However, it will also serve as a ready reference to mine management and to research workers operating in the field, and will furnish the design needs of environmental engineers.

The book is larger than A5 size and has large print that makes it easy to read. The quality leaves nothing to be desired; the diagrams and illustrations are of high standard. The colour photographs that are used in the chapter on refrigeration practices give pleasant relief; in fact, the use of colour might have been extended to some advantage.

● *Underground Operators Conference. West Coast Tasmania Branch.* Australasian Institute of Mining and Metallurgy.

Reviewer: D. R. Aspelng

The papers presented at this Conference deal exclusively with underground mining operations employing either cut-and-fill or open-stope mining methods. Most of them deal with the drilling, charging, and blasting of stopes, the wrecking of pillars between open or filled stopes, and the subsequent filling of these stopes.

The initial planning of stopes, the design of various types of mine accesses, and the extension of accesses to lower portions of a mine are discussed. Some papers describe special excavating methods such as the raise-boring of shafts and long-hole raising. Rock mechanics, methods of ground support, underground pumping and conveying systems, and the legal aspects of Common Law damages are also discussed. A few papers deal with subjects such as the criteria for the selection of underground production equipment and the introduction into an underground environment of new trackless equipment such as LHD machines, drill jumbos, and special service vehicles.

Besides being of general interest and also giving an insight into mining in Australia, these papers could serve as a useful reference for mines employing, or intending to employ, a generally used type of metalliferous mining method.

2. New publications

● *Electric steelmaking in the eighties: challenges and opportunities.* Rotterdam, Balkema, 1982. 362 pp. \$50.00 or £33.

The proceedings of the international conference held in Bangalore (India) in January 1982 offer an exchange of international experience in electric steelmaking that will contribute to increasing the efficiency of this industry worldwide. Electric steel plants have achieved a lower capital intensity, remarkable flexibility in the matter of inputs and processes, and a widening range of output. The challenge of steelmaking in the 1980s is different in each country but, in those areas of the world where industrialization is still in its early stages, the use of small electric steelmaking units may offer the chance to become independent of the steel exports of other countries without the task of providing large capital sums to launch into the multimillion-ton steel league.

● *Tungsten: a review*, by P. M. Harris and D. S. C. Humphreys. London, Institution of Mining and Metallurgy (Occasional Paper 2), 1983. Members: £3, non-members £6.

The review covers resources and extraction, and uses and economics, with tabulated information on major mines, principal exporters and importers, and consumption.

● *The platinum industry — prospects in recovery.* London, Shearson/American Express Ltd (St. Alphage House, 2 Fore Street, London EC2Y 5DA), 1983. £75.

This is a comprehensive report on one of the world's most strategic industries — platinum. The coverage

includes producing countries (geology, reserves, outputs, trading policies), producing companies (traditional and developing end-uses, impact of technology), recycling, substitution, pricing policies (producer and free-market systems, futures trading), the impact of gold (precious-metals price ratios), and the political dangers (platinum as a strategic metal).

● *The best of E&MJ mining and processing idea book* New York, Engineering and Mining Journal, 1983. 128 pp. Free with subscription to *Engineering and Mining Journal*.

This is a collection of 27 selected articles from recent issues of the *Journal*. They discuss the latest methods and equipment in exploration geophysics, open-pit mining, drilling and blasting, crushing and grinding, maintenance of mining equipment, etc.

● *Mining 1983*. Harlow (U.K.), Longman Group Limited, 1983. 500 pp. £39.50.

This new edition, completely reworked and produced in a new format, features several new sections, as well as providing the usual update of essential information on companies involved in all aspects of the mining industry worldwide — approximately 740 this year. The presentation has been improved by the change to a larger page size and to double-column type, making reference easier. The new sections are as follows: three-year comparative financial results for individual company entries; separate listing of mining and metals associations; maps showing the location of mining activities worldwide; entries for top oil and gas companies currently involved in buying up mining interests; geographical index — listing, in the country of operation, the mining, exploration, and development companies and/or their subsidiaries.

● *Concise guide to world coalfields*. London, World Coal Resources and Reserves Data Bank Service (14/15 Lower Grosvenor Place, London SW1W OEX), 1983. 380 pp. £45.

For each coalfield, this guide provides particulars of geology, coal-seam characteristics, coal rank, and analysis, plus a brief reference to any local mining activity. Maps of main coal-bearing countries show clearly the location of significant coalfields in relation to rail-transport facilities and major ports, plus other coal deposits of less importance. A glossary of terms provides terse definitions of all the words and expressions used in the text that might not be immediately understood by the lay reader, and also indicates where any words have been used in a special limited sense.

3. Canadian publications

The following reviews of the activity and developments during 1980 in respect of the chief minerals produced or consumed in Canada are now available. Prepared by staff of the Mineral Policy and Energy Sectors, they are available at \$1.00 per copy from the Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Canada K1A 0S9. Orders should be accompanied by postal money orders payable to the Receiver General for Canada.

● *Asbestos*, by G. O. Vagt, 9 pp.

● *Coal and Coke*, by J. A. Aylsworth, 16 pp.

● *Crude oil and natural gas*, by R. L. Thomas, 12 pp.

● *Phosphate*, by G. S. Barry, 8 pp.

● *Rhenium*, by S. A. Hamilton, 3 pp.

4. Mintek reports

The following reports are available free of charge from the Council for Mineral Technology, Private Bag X3015, Randburg 2125, South Africa.

● Report 2102D

The recovery of magnesite from dump fines from the Strathmore Mine. (First issued Feb. 1981.)

The results are given of scrubbing and magnetic-separation tests on dump fines having a magnesite concentration of about 40 per cent.

It is concluded that only material larger than 3,0 mm in size will be amenable to concentration to yield a product assaying less than 4,0 per cent silica, and that the mass yield will be low, at approximately 4,0 per cent of the total sample tested. It appears that the material from which this amount can be recovered constitutes only 7,6 per cent of the dump fines.

● Report 2106D

The evaluation of drill cores and a bulk sample from a deposit of andalusite near Thabazimbi. (First issued Mar., 1981.)

Twelve drill cores were tested, procedures involving standard attrition scrubbing and heavy-liquid separation being used in a determination of the grade and yield (recovery) of andalusite. Of the twelve cores, nine were found to contain andalusite of a grade that would be acceptable to the consumer. Eight of these cores gave andalusite yields exceeding 7,0 per cent of the original material. The average grades for the nine cores were 57,7 per cent alumina and 0,89 per cent ferric oxide. High-intensity magnetic separation was required to reduce the ferric oxide concentration to below 1,0 per cent. The average yield of andalusite was 7,7 per cent. A confirmatory test on a composite sample of the cores showed that the use of a modified mill would be beneficial in improving the yield of andalusite.

Attrition milling tests on a bulk sample of the ore showed this sample to be inferior to the core samples, and the ferric oxide concentration of the andalusite concentrates was considerably higher. By use of a modified rod-milling technique, a concentrate assaying 57,0 per cent alumina and 1,70 per cent ferric oxide was obtained. The yield of andalusite was 7,5 per cent.

A washability test on the andalusite concentrate showed that the fractions of the concentrate with relative densities lower than 3,05 and higher than 3,15 had a low alumina and a high ferric oxide content, and that treatment of the ore could therefore be difficult in a conventional heavy-medium concentration plant. No apparent reasons could be found for the difference in quality between the core samples and the bulk sample.

It is concluded that the ore, as represented by the core samples, is readily amenable to beneficiation, and will

produce an acceptable grade and yield of andalusite. However, the bulk sample contains a large proportion of hard, highly ferruginous material that could affect the quality of the andalusite concentrates and make treatment of the ore more difficult.

● Report 2108D

Evaluation of a grinding aid in batch grinding, classification, and gravity concentration. (First issued Jul. 1981.)

Three important aspects of mineral-beneficiation practice, viz batch grinding on a laboratory scale, classification, and gravity separation, were analysed in a determination of the effect of a grinding aid made by Dow Chemicals, XFS U.272.00, on each of their respective process environments.

For the batch-grinding environment, it was found that fairly severe process conditions (a pulp density of 85 per cent solids, grinding aid at a concentration of 2 kg/t, and a grinding time of 30 min) were necessary before significant increases were achieved in the grinding rates. These process conditions produced an average increase in the fineness of the product of 4,7 per cent.

The effect of the grinding aid on classification was studied by the passing of the pulp, in turn, through 25 mm and 50 mm hydrocyclones and a 150 mm spiral classifier, different additions of grinding aid being used in each case. The results showed that there was a tendency for the uncorrected cut size to reduce slightly, and for the sharpness of particle classification to improve marginally when the aid was introduced.

Closed-circuit tests with a spiral concentrator showed that dosages of between 50 and 300 g/t improved the grade and recovery of concentrate, but that, at dosages of 500 g/t, the grade and the recovery began to decrease.

● Report 2109D

The evaluation of an andalusite deposit from Kleinfontein, Groot Marico. (First issued Apr. 1981.)

High-grade andalusite deposits occurring on the farms Kleinfontein 260JP and Driefontein were evaluated by the application, to a number of drillhole cores, of the standard test procedure used at Mintek.

It was concluded that, from the Kleinfontein area, a product assaying 58,7 per cent alumina and 1,22 per cent ferric oxide can be obtained at a recovery of 5,6 per cent. Similar results were obtained from Driefontein cores. The low recovery was attributed to the hardness of the shales.

The milling of composite samples of borehole cores in a modified rod mill with a low charge of rods increased the andalusite recovery to 8,1 per cent for the Kleinfontein cores and 10,1 per cent for the Driefontein material. The latter material assayed 59,5 per cent alumina and 0,90 per cent ferric oxide after magnetic separation. The removal of primary fines smaller than 4 mm before milling contributed greatly to the higher recoveries.

The treatment of a bulk sample by crushing, screening, and milling of the oversize in a modified rod mill, followed by heavy-medium separation and magnetic separation, gave a product assaying 59,2 per cent alumina and 0,86 per cent ferric oxide. A final recovery of 8,0 per cent was obtained.

It was concluded that the ore is amenable to beneficia-

tion and that an economic recovery at the required grade can be obtained readily by use of the modified procedure developed for this ore.

● Report M7D

The beneficiation of chromite ore from the MG-1 seam near Marikana. (First issued Nov. 1981.)

The investigation of a run-of-mine chromite deposit from the MG-1 seam in the Marikana district is reported.

Tabling and spiral concentration of the ore showed that the deposit is of good grade and would be suitable for the production of a good chromite concentrate. A concentrate assaying more than 44 per cent Cr_2O_3 and between 1 and 2 per cent SiO_2 would be very easily produced by spiral concentration, since very high chromite recoveries (approximately 85 per cent) were achieved during the treatment of the natural fines. Milled fines would give inferior results that could be improved to the same grade by multistage cleaning.

Although the production of a concentrate assaying more than 46 per cent Cr_2O_3 and less than 1 per cent SiO_2 would be more difficult, it should nevertheless be possible by the use of different operating conditions. However, the chromite recoveries would be lower and should be confirmed by further tests on a pilot-plant scale.

The flowsheet for beneficiation of the ore is based on the results given in the report, as is an alternative procedure in which two grades of concentrate can be produced.

It is recommended that hindered-settling classification should be tested on the concentrates as a further method for the production of the required grades.

● Report M62

A preliminary investigation into the extraction of zinc by direct oxidative leaching of high-manganese sphalerite.

The direct oxidation of zinc sulphide ores in the spent electrolyte from zinc electrowinning cells has emerged as a viable alternative to the established practice in which ore is first roasted to form a readily soluble oxide.

Laboratory-scale work on the development of a process flowsheet for a specific sphalerite ore with a high content of manganese is described. This process involves the introduction of a stage in which the build-up of manganese is advantageously controlled by its extraction as battery-active electrolytic manganese dioxide, which is commercially valuable.

The importance of the ferrous-ferric redox couple in the oxidative leach is described, and the advantages of its optimization is demonstrated, with zinc dissolution values of up to 99 per cent.

The problems associated with the recycling of the iron in the leaching solution, and with metallic impurities that must be eliminated prior to the electrowinning of zinc, are discussed, together with the procedures adopted to give satisfactory results.

● Report M76

A mineralogical investigation of a refractory gold ore, and of a sulphide concentrate and calcined tailing from that ore.

This report covers an investigation into the manner of occurrence of gold in an old mine dump of calcined tailings at the Fairview Mine. Previous investigations had not revealed the whereabouts of the gold still present in this dump, which amounts to between 10 and 12 p.p.m. In the present investigation, in which heavy-liquid separation was combined with X-ray, microscope, and electron-microprobe investigations, it was found that a significant proportion of the gold is adsorbed on carbon, and that a smaller proportion is present in pyrite that escaped complete calcination.

An enigma is the occurrence of ferrosilicon, some of which contains gold. Although this study produced new information, a more detailed quantitative investigation is required in which an image analyser should be used to provide reliable quantitative data.

● Report M85

List of unrestricted Mintek publications issued from 1966 to 1982.

This publication lists the 834 unrestricted reports, 449 papers, 41 patents, and 4 other technical publications that were issued as publications of the National Institute for Metallurgy (NIM) and the Council for Mineral Technology (Mintek) from 1966 (the year of NIM's inception) to 31st December, 1982. For ease of reference, these publications are also classified under research topics.

Also included are details of the periodical issued by Mintek and a list of its current miscellaneous publications, which include the annual report, and brochures and leaflets of various kinds.

● Report M97

Reduction in metal consumption by the use of alternating lines of higher and lower lifter bars in a rod mill.

A change was made in the arrangement of lifter bars in the No. 2 rod mill (9 ft by 12 ft) at the Kloof Mine. During complete relining the year before, the mill was fitted with alternating lines of lifter bars 105 and 75 mm in height. One test line of 105 mm plain carbon-steel bars, hardened and tempered, was fitted in the mill at that time to permit comparison of the wear resistance with that of the manganese-steel bars normally used.

The results obtained showed a substantial saving in the consumption of liner metal: 370 000 t of ore were milled before the lifter bars needed to be replaced — an

increase of 34 per cent. Only one half of the lines of lifter bars was replaced, 105 mm bars being fitted into the lines formerly occupied by 75 mm bars. The fineness of grind of the product was not affected adversely, and the consumption of power per ton of ore fed to the mill was marginally lower.

The line of plain carbon-steel lifter bars showed better resistance to wear than the manganese-steel bars, but the tendency of the carbon-steel bar to crack during service will need to be reduced before its use can be recommended.

● Report M98

Multivariable control and optimization of the operation of a milling circuit at East Driefontein Gold Mine.

This report describes the successful application of a multivariable controller to an industrial milling circuit. Setpoints for the controller are the particle size of the product, and the flowrate and density of the slurry fed to the primary cyclones. Simple guidelines have been established for the selection of optimum setpoints that maximize the throughput at the chosen size of product.

● Report M101

The potentiality of heat-treated balls in the grinding of gold ores.

A major investigation was made of the life and performance of heat-treated grinding balls in the 9 by 10 ft No. 1 ball mill at Libanon Gold Mine.

The standard 100 mm cast semi-steel balls commonly used to grind gold ores are not suited to heat treatment. The composition was therefore altered so that suitable hardening and tempering would give the balls a Brinell hardness of 550 to 600 as against the 330 to 380 of the standard balls.

During a 24-week test, 160 t of these heat-treated balls was added to the mill. The performance of the balls, which was monitored at weekly intervals, showed an improvement of 27 per cent over that of the standard balls.

A technique was developed that permitted rapid determination of the 'average diameter' of the balls within the mill. These results were correlated with the fineness of the grind (as measured by the harmonic mean size of the product), the power consumption, the volume of the grinding charge in the mill, and the rate of addition of the balls.

X-ray diffraction

The Southern Transvaal Section of the South African Chemical Institute is to present a mini-course on 'X-ray Diffraction: Theory and Application' in Johannesburg on 18th and 19th October, 1983.

The course will cover the introductory theory of X-ray diffraction and practical applications with the emphasis on the powder technique.

The course will be of benefit to those who use this technique for both research and routine applications. In addition, the course will provide background information to those interested in the scope and versatility of this subject.

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