

Book review

H. W. Glen (ed.). *Proceedings of Asbestos Symposium, Johannesburg, South Africa, 3rd-7th October, 1977*. Randburg, National Institute for Metallurgy, 1978. 158 pp. (Copies obtainable from the Department of Mines, P.O. Box 4584, Johannesburg, 2000 South Africa.)

This Symposium, which concentrated on the theme of dose-response relationships for asbestos-related diseases, was attended by an internationally representative group of experts in this field. The Proceedings include the papers presented by the introductory speakers at each session, together with summaries of the discussions. In addition, the volume includes a foreword by the Honourable S. P. Botha, Minister of Labour and of Mines, who gave the Opening Address at the Symposium, a list of participants with their addresses, and an account of a study on the radiological assessment of pneumoconiosis that was conducted on the day before the Symposium started.

The following topics were discussed individually at separate sessions, and together at two sessions at the end of the Symposium:

- the value and reliability of the measurement of health-impairment parameters that are used in the establishment of asbestos dose-response relationships.
- the value and reliability of the methods used in the measurement of asbestos-dust exposures.
- acceptable epidemiological methods in the establishment of dose-response relationships for asbestos-related diseases

- dose-response relationships for non-malignant asbestos-related diseases
- dose-response relationships for mesothelioma
- dose-response relationships for other malignant asbestos-related diseases
- various matters relating to susceptibility to asbestos-related diseases.

The following, from among the areas suggested for future research at the last session of the Symposium, were regarded as priority areas.

- (1) The prognostic significance of the many available 'indicators' of asbestos-related diseases should be assessed individually and in combination for disability, development of cancer, or death.
- (2) 'Indicators' of functional disability (rather than of death) should be developed and used.
- (3) X-ray findings should be related to pathology data to provide information on what is to be regarded as a normal radiological finding and what is pathological.
- (4) Methods of assessing the effect of low asbestos exposures should be investigated.
- (5) Methods should be developed and applied for long-term epidemiological surveillance of the workers exposed to low concentrations of asbestos dust.
- (6) The effects of dust of different asbestos types and particle sizes should be studied.
- (7) The effect of short high exposure as opposed to continuous low exposure should be investigated.

H.G.

Bulk solids

The Powder Advisory Centre announces its third annual International Conference on Bulk Solids Storage, Handling and Flow, to be held at the Holiday Inn, Liverpool, on 7th to 9th November, 1978. This sequel to the extremely successful November '76 Stratford and November '77 Nottingham Conferences is again to be co-sponsored by a number of internationally acknowledged professional societies, including the Institute of Materials Handling (through its Bulk Solids Panel), the Institution of Production Engineers, and the American Society of Mechanical Engineers (through its Materials Handling Engineering Division). The Conference will again be organized by the Powder Advisory Centre.

This year's Conference theme will be somewhat different from the previous two years in that it moves away from the areas of hoppers and pneumatic conveying and is less concerned with higher-tonnage industries such as steel and coal. The Conference will be concerned this time with plant-scale powder handling and pro-

cessing, emphasizing the importance of integrated plant design. The emphasis throughout will be on industrial practice and the useful applicability of the results of fundamental research. Full audience participation will be encouraged, and adequate provision will be made in the timetable for discussion periods and trouble-shooting sessions.

The broad-based and international professional sponsorship of this event will ensure a significant programme, which is being arranged by a special Committee comprising Dr P. L. Bransby (Warren Spring Laboratory), A. S. Goldberg (Powder Advisory Centre), Dr H. Wright (British Steel Corporation), and others.

Papers are solicited for this Conference and should be submitted to the Powder Advisory Centre by 30th June, 1978, at the latest, when the final Programme will be constructed. The address is as follows: Powder Advisory Centre, P.O. Box 78, London, NW11 0PG, England.

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. 1943

A review of the literature on the separation and determination of rare-earth elements. (23rd Mar., 1978.)

Data on the available methods of analysis are collated, possible separation and concentration procedures are considered, and brief consideration is given to the applicability of the various analytical techniques.

Report no. 1947

The cation- and anion-exchange behaviour of various base-metal chlorides in polar organic solvents. (10th Mar., 1978.)

Graphs at equilibrium loading are presented for the extraction of various metal chlorides from polar organic solvents and mixtures of organic-aqueous solvents by the anion exchanger Amberlite IRA 400 and the cation exchanger Zerolit 225. The metals studied are copper(II), cobalt(II), nickel(II), iron(II), zinc(II), lead(II), and iron(III). The solvents are acetonitrile, propylene carbonate, and sulpholane, which, as cation solvators, are all weaker than water; and dimethylsulphoxide, dimethylformamide, and dimethylacetamide, which, as cation solvators, are better than water. It is shown that the selectivity of the resins for the various metal ions can be explained on the basis of the chlorocomplex stability of the metals and the solvating power of the solvents.

Report no. 1948

The measurement of trace amounts of gold in solution by atomic-absorption spectrophotometry and carbon-rod atomization. (28th Feb., 1978.)

This report describes an investigation into the measurement of gold in solution by flameless atomic-absorption spectrophotometry and carbon-rod atomization.

The interferences from eleven elements were studied, particularly those associated with solutions resulting from the cyanidation of gold in the mining industry. Serious interference from the alkali metals was encountered and overcome. Interferences from the other elements examined were less severe, but their presence constitutes a limiting factor.

Details are given of a proposed method for the determination of gold down to 0,005 p.p.m. in cyanide solutions that has a precision of 6,5 per cent at a concentration level of 0,06 p.p.m.

Report no. 1949

The kinetics of the leaching of zinc sulphide concentrates in acidic solutions containing ferric sulphate. (23rd Mar., 1978.)

A preliminary study has been made of the effects of several variables, such as temperature and the concentration of acid and iron(III), on the rates of dissolution in sulphate of four sphalerite solution concentrates of

different origin. It is shown that no single rate equation can describe the leaching characteristic of the various samples, and tentative mechanisms based on rate-determining oxidative and non-oxidative processes are proposed.

Report no. 1950

Factors affecting the carbon contents of alloys formed during the prereluction of chromite ores. (31st Mar., 1978.)

The mechanism and rate of reduction with spectrographic carbon of fines of two chromite ores were studied for temperatures from 1100 to 1500°C. The ores consisted of a Rhodesian chromite ore with a ratio of chromium to iron of approximately 3,2 and a Transvaal chromite ore for which the ratio is about 1,5. The particle size of the ores was between 100 and 150 Tyler mesh, and the spectrographic carbon consisted of material smaller than 325 Tyler mesh. The carbon contents of the alloys obtained by reduction were determined as a function of percentage metallization and the temperature of reduction.

It was found that the carbon content of the alloy varied with the percentage metallization, and was from 2 to 4 per cent by mass at between 80 and 90 per cent metallization at a reaction temperature of 1500°C. As the reaction temperature increased from 1100 to 1500°C, the sequence of carbide formation for the Winterveld ore was Fe_3C to Cr_7C_3 to Cr_{23}C_6 . For this ore, transformation of the carbide Cr_7C_3 to Cr_{23}C_6 probably occurred as a result of saturation of the carbide lattice by iron to form $(\text{Cr,Fe})_7\text{C}_3$, which then went through a structural change to $(\text{Cr,Fe})_{23}\text{C}_6$ with the release of iron owing to the different capacities of the two carbides to dissolve iron into their structures.

For the Winterveld ore, the rate of reduction seemed to be governed mainly by the rate of nucleation and the iron content of the ore, which accelerated the rate of reduction by the formation of an intermediate carbide, Fe_3C , or by the dissolution of carbon in iron.

Report no. 1952

The effect of slag composition on copper losses to silica-saturated iron silicate slags. (31st Mar., 1978.)

The effect of fluxing additions of magnesia, alumina, and lime on the solubility of copper in silica-saturated iron silicate slag at 1573 K was studied by the contacting of copper-gold alloys with the slag in silica crucibles under a partial pressure of oxygen of $8,106 \times 10^{-7}$ kPa (8×10^{-9} atm). The oxygen partial pressure was controlled by use of a mixture of carbon monoxide and carbon dioxide.

The results of this investigation confirm that copper is dissolved as $\text{CuO}_{0,5}$ in silica-saturated fayalite slag. The effect of additions of magnesia, alumina, and lime on the solubility of copper in slag was determined by the calculation of the activity coefficient of copper oxide for each of these flux additions. The values of the activity coefficient of copper oxide in this investigation varied from a minimum of 2,58 for silica-saturated slags without fluxing additions to a maximum of 3,81 for a

slag with a lime content of 10,5 mass per cent. Additions of magnesia and alumina increased the activity coefficient of copper oxide slightly, and additions of lime increased it substantially.

Equations were obtained that related the solubility of copper in the slags to the activity of $\text{CuO}_{0.5}$ in them. The maximum solubility of copper in the slag equilibrated with a copper-gold alloy ($a_{\text{Cu}}=0,80$) varied from a maximum of 2,10 mass per cent for slag without fluxing additions to a minimum of 1,40 mass per cent for slag with a lime content of 10,5 mass per cent. The variations in the solubility of copper in the slags were consistent with the acid-base theory of slags.

The knowledge obtained in this investigation will be helpful in the choice of optimum compositions for copper-smelting slags that will reduce losses of copper to these slags.

Report no. 1953

A fundamental investigation into the depression of copper-activated sphalerite. (28th Apr., 1978.)

An investigation is reported into the conditions under which sphalerite is induced to float naturally.

It has been found that, whereas cyanide deactivates copper-activated sphalerite, it does not effectively reduce the natural floatability of the mineral. This fact probably accounts for the limited depression effected by cyanide alone in many practical flotation situations.

Various precipitated species, e.g. zinc hydroxide and zinc cyanide, effectively depress naturally floating sphalerite and the activated mineral reacted with xanthate, and are partially effective as depressants for xanthated chalcopyrite. However, both in small-scale and bench-scale flotation tests, sphalerite was separated from chalcopyrite. Soluble species, e.g. free cyanide and complexes of zinc and cyanide, cannot depress the natural floatability, but can deactivate and depress a xanthated surface lacking any such inherent floatability.

Measurements of contact angles were made on polished mineral surfaces, and the extent of the reaction of sphalerite and chalcopyrite with copper solutions and with xanthate as separate minerals, and together in mixtures, was measured.

The experimental evidence supports the hypothesis that the selective depression of sphalerite by systems containing precipitates is not due to selective adherence of the precipitate to the zinc sulphide surface. It appears that, in mixtures of sphalerite and chalcopyrite, the floatability of both minerals is reduced but that, owing to its greater hydrophobicity, chalcopyrite is still re-

coverable, whereas the less hydrophobic sphalerite is satisfactorily depressed.

Report no. 1956

An improved ion-exchange separation of rare-earth elements for spectrographic analysis. (10th Mar., 1978.)

Rare-earth elements are separated from scandium and base metals by adsorption onto anion resin BIORAD AG1-X8 in the nitrate form from a mixture of 5 per cent 7 M nitric acid and 95 per cent methanol. The yttrium subgroup is eluted with a mixture of 45 per cent 7 M nitric acid and 55 per cent methanol, followed by elution of the cerium subgroup with 8 M nitric acid. This separation facilitates the determination of the traces of the heavier yttrium subgroup of rare-earth elements.

Report no. 1960

The recovery of ferrochromium from furnace slags and related products. (20th Aug., 1976; declassified 31st Mar., 1978.)

Three types of slag from the ferrochromium furnaces at Middelburg Steel and Alloys (Pty) Ltd were used in preliminary tests that were aimed at the development of a technique for the recovery of the metal content of slags. It was concluded that magnetic separation and jigging of the finer sizes after liberation of the metal by crushing would yield the best results.

Plant-scale magnetic-separation tests on five samples from the slag dump confirmed that the technique was suitable, and concentrates with ferrochromium grades of more than 93 per cent were obtained from material larger than 13,0 mm in size. A typical result from one sample showed the material to have a metal content of about 11 per cent, of which approximately 68 per cent was recovered at a ferrochromium grade of 93,9 per cent.

Attrition tumbling was used to improve the purity of the concentrates to the level required for them to be salable. It was found that this method could produce concentrates having ferrochromium grades of more than 97 per cent. Metal lost as fines amounted to about 16 per cent (by mass) of the original concentrates.

Conductivity sorting, as a means of recovering the metal not susceptible to magnetic separation, failed to yield salable grades in a single treatment stage.

Alternative flowsheets for a plant to treat 15 000 kilograms per hour are included for consideration, and magnetic separation and attrition tumbling are essential features of the treatment process.

Process instrumentation

The National Institute for Metallurgy and the South African Institute of Measurement and Control are organizing a symposium that will draw the attention of researchers and industrial workers to the importance of metallurgical process instrumentation. The symposium is to be held in the Auditorium of the National Institute for Metallurgy on 20th and 21st September, 1978.

The following papers are to be presented:

Opening address: Professor W. J. Taute (President, S.A. Institute of Measurement and Control)

'The measurement and control of lime concentration in alkaline slurries using electrodeless conductivity systems' by G. T. W. Ormrod (National Institute for Metallurgy)

'Flow-rate measurement using correlation' by J. Leitner and D. E. H. Naude (NIM Research Group, University of Cape Town)

'On-line determination of size distribution by sedimentation' by K. J. Scott (CSIR)

'A comparison of batch versus continuous mass flow measurement techniques in a continuous blending process' by G. A. Oliver (Sprout Waldron of S.A. (Pty) Ltd)

'Ore and concentrate weighing at Palabora Mine' by W. G. Moffat (Palabora Mining Company Ltd)

'A prototype intelligent ratio controller for coal blending at coke ovens' by D. C. Farquharson, C. Kuiper, and G. F. J. Turner (ISCOR)

'The effects of centralized control on instrumentation

and motor control centres' by R. Brimmer (Anglo American Corporation Ltd)

'Applications for microprocessors to grinding mill circuit control' by I. Kimmel and A. L. Hinde (Chamber of Mines Research Organisation)

'In-stream size distribution measurements for grinding circuit control' by J. A. Herbst (University of Utah, U.S.A.)

'Development of a grinding circuit control system' by M. F. Sadler (Rustenburg Platinum Mines)

'Aspects of grinding circuit measurement and control' by D. G. Hulbert and M. H. Moys (National Institute for Metallurgy)

'Experience with the introduction of microprocessor systems into industry' by G. T. Gray and J. H. Potgieter (National Institute for Metallurgy)

'The application of a programmable logic controller to a 3-flask load-out station' by D. Apetauer (Engineering Management Services)

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