

Book news

1. Publications of the World Mining Congress

The Austrian National Committee of the World Mining Congress has developed a series of mining data, and has published these in a form that complements the long-established *World Mineral Statistics* produced by the British Geological Survey. This comprehensive summary of mineral-industry data covers over 150 countries and some 45 commodities (iron and the ferro-alloy metals, non-ferrous metals, precious metals, fuel minerals, and industrial minerals). The statistics are presented by commodity, country, and regional/economic groupings, and cover the period 1984 to 1988.

Copies of these publications are obtainable from Österreichisches Nationalkomitee, c/o Fachverband der Bergwerke und Eisen erzeugenden Industrie, P.O. Box 300, A-1015 Vienna/Austria. (Fax: 0222 512 46 01/20). The publications may be ordered by advance payment to account no. 0121-01705/00 at the Creditanstalt Bankverein in favour of Bundeskammer der Gewerblichen Wirtschaft Wien (reference Welt-Bergbau-Daten 201016003).

- Series A: Volume 5 *World mining data '90*. US\$25.
- Series B: Volume 1 *Chromite*. US\$31.

2. Randol publications

The following publications are available from Randol International Ltd, P.O. Box 150632, Lakewood, CO 80215, U.S.A.).

- *Randol Gold Conference, Sacramento '89*. 1990. 400 pp. \$80.

This volume contains the proceedings of the Randol Gold Conference '89, which was held in Sacramento late last year.

- *Randol mining directory 1990-1991*. 1990. \$100.

This directory lists US mines, and mining companies, associations, and schools, together with exploration contacts, production data on reserves and grades, government contacts, and forecasts for the 1990s.

- *Randol buyer's guide USA and Canada*. 1990. \$50.

This guide includes products and professional services, products and services, manufacturers and suppliers, consultants, and financial institutions.

3. New journal

- *Industrial Metrology*, edited by A. Choudry *et al.* Amsterdam, Elsevier Science Publishers, 1990. Dfl. 266 incl. postage for 4 issues per year.

The aim of this journal, described by the publishers as 'the international journal of automated measurement and control', is twofold: to address the issues related to the development of metrologic techniques and their integration in the industrial environment; and to enhance a rapid exchange of information between the industrial and research communities. The journal plans to cover the following and allied topics:

- Process Control
- Quality Control
- Diagnosis
- Health-Monitoring
- Sensor Data Processing and Communication
- Data Archiving and Retrieval (DBMS)
- Decision Support.

4. Mintek reports

The following reports are available from Mintek, Private Bag X3015, Randburg, 2125 South Africa. They are available at R35 (including GST) per copy to South African addressees, and US\$30 per copy (including air-mail postage) to addressees elsewhere.

Report M130D

The application of a standard leaching procedure to tin-tungsten concentrates from Van Roois Vley deposit: Cross-cut bulk samples, by M.M. Fieberg and C.F.B. Coetzee. First issued 1984, reissued 1990. 11 pp.

Mintek was asked to investigate the feasibility of treating tin-tungsten concentrates from different areas of Van Roois Vley deposit by a standard leaching procedure. These concentrates were derived from bulk samples that had been taken from underground exploration operations.

The tests showed that, at a particle size of 100 per cent smaller than 106 μm , only five samples were readily digested with 10 M hydrochloric acid and had a tungsten recovery of more than 99 per cent. Extractions of more than 94 per cent were obtained from nine samples, whereas only 90,6 per cent was recovered from one sample (cross-cut 14).

The tungsten extraction improved considerably when the standard leaching procedure was employed on samples ground to 100 per cent smaller than 38 μm , a recovery of more than 99 per cent being obtained from eleven samples. For the remaining four samples, the tungsten yield amounted to more than 94 per cent.

If all the samples were combined, tungsten trioxide in the cassiterite residue would average 3,07 per cent from feed material with a particle size of 100 per cent smaller than 106 μm , and to 1,48 per cent from a feed of 100 per cent smaller than 38 μm .

Report M160D

The recovery of graphite from the Messina district, by R.N. Guest. First issued 1984, reissued 1990. 22 pp.

A graphite product consisting of coarse flakes and having a carbon content of over 89 per cent was produced by pneumatic concentration and wet high-intensity magnetic separation. Flotation recovered about 80 per cent of the fine graphite at a grade of over 75 per cent.

Leaching with dilute hydrochloric acid increased the carbon content of the coarse flakes by about 4 per cent and the flotation concentrate by up to 15 per cent; however, the consumption of acid was high.

A brief costing exercise showed the ore *in situ* to be worth about R20 per ton, and a possible procedure by which this value can be increased is suggested.

Report M305D

The beneficiation of nickel-copper ore from Uitkomst, by P.W. Overbeek. First issued 1987, reissued 1990. 55 pp.

Samples of ore from the Uitkomst deposit were treated by a number of beneficiation techniques to establish a flowsheet for the economic recovery of nickel and copper. These techniques included pre-concentration by sorting, heavy-medium separation, magnetic separation, and gravity concentration through spiralling at a coarse size.

Flotation tests were carried out to confirm, and in an attempt to improve on, results obtained in a previous investigation, and bacterial leaching was conducted on ore and on concentrates derived from the heavy-medium separation and flotation tests.

None of the pre-concentration techniques tested gave acceptable metal recoveries in a low mass of concentrate, and there was no improvement in liberation when the ore was reduced in size.

Heavy-medium separation was successful in rejecting the acid-consuming constituents of the ore that would be deleterious to bacterial leaching.

A modified flotation procedure was developed that compared favourably with the initial procedure, but the recoveries of metal were still approximately 20 per cent below those obtained initially.

Mineralogical examination showed that the ores were highly oxidized, which accounts for the lower recoveries by flotation. The ore samples as received do not appear to be representative of the orebody.

The results of the bacterial-leaching tests showed promise, and this procedure should be considered as a means of treating concentrate rather than the whole ore. The removal of acid-consuming constituents by heavy-medium separation will give high recoveries of metal and, although the mass rejected as waste is not high (28 per cent), the resulting concentrate is amenable to bacterial leaching.

The non-representativeness of the ore samples and the high degree of oxidation place some constraints on the interpretation of the test results, and it is possible that fresh ore representative of the orebody will give more meaningful and positive results.

Report M320D

The flotation of pyrite from Buffelsfontein Gold Mine, by A.M.R. Botelho de Sousa and V.E. Ross. First issued 1988, reissued 1990.

The aim of the investigation was the reduction of the losses of gold and pyrite in the flotation plant at Buffelsfontein Gold Mine.

Laboratory-scale batch tests showed that the recovery of pyrite is decreased in the presence of sulphates of magnesium, calcium, and iron, or in the presence of cyanide if copper sulphate is absent. The recoveries are increased with increased conditioning times and residence times. Both the grade of concentrate and the rate of flotation are influenced by the temperature of the pulp, and conditioning with sulphur dioxide is beneficial. The grade of the concentrate is influenced by the dosage of collector. The present dosage of 100 g/t is satisfactory.

Various methods for the oxidation of residual cyanide were tested. Alkaline flotation after the oxidation of cyanide by chlorination and by sodium sulphite and air yielded similar recoveries to the standard acid flotation, but the sulphur grade of the concentrate was lower.

The relationship between residence time and flotation

performance was quantified. The results of laboratory batch tests were scaled up and used in a computer simulation of the flotation circuit. The recycling of the recleaner tailings to the head of the rougher bank would increase the recoveries of gold and sulphur by 8 and 10,4 per cent respectively. The recoveries could be further increased by increased residence times.

Report M347D

Autogenous milling of ore from the UG-2 Reef, by J.K.H. Lichter. First issued 1988, reissued 1990. 13 pp.

A 65 t sample of UG-2 ore from the vertical shaft at Maandagshoek Mine was tested for its amenability to fully autogenous milling. The tests were carried out in a pilot autogenous mill, which consists of an Aerofall mill of 1,7 m diameter and 0,5 m length fitted with 20 mm peripheral discharge grates or a 125 mm pebble port. The milling circuit was closed by a 1,2 mm or a 0,79 mm screen, and the pebble port allowed pebbles between 50 and 125 mm to be sorted and removed from the mill discharge.

The sample was found to be ideally suited to autogenous milling, since the chromite ore was friable, and the harder gangue was a competent grinding medium, allowing very high throughputs to be attained. The removal of barren gangue rock improved the throughput by 57 per cent. The chromite in the mill product was fully liberated, and the mill product was acceptable. There was no build-up of material in the critical-size range.

Design exercises were carried out, with and without the removal of barren pebbles, to establish the dimensions required for a typical mill of 90 t/h capacity to provide a product with a d_{80} of approximately 300 μm . It was found that, with no removal of barren pebbles from the circuit, a mill of 3,6 m diameter would need to be 3,7 m long, whereas, if the barren pebbles were removed, it would need to be only 2,3 m long. Flotation and spiral concentration tests were carried out on the mill product to establish the recovery of the platinum-group metals.

Report M352D

Fly ash as an adsorbent or precipitation agent in the removal of ionic species from solution, by C. Pohlandt-Watson, S.M. Graham, and K.F.G. Brackenbury. First issued 1988, reissued 1990. 9 pp.

Samples of pulverized fly ash from two coal power stations (Matla and Duvha), and floated cenospheres from a third (Camden), were examined for their ability to extract cationic and anionic species from aqueous solutions. Two different mechanisms appear to be involved in the removal of ionic compounds from the liquid phase. A limited degree of adsorption onto neutral fly ashes was observed for cations and anions from acidic and neutral solutions respectively. With the basic Matla fly ash, the dominating mechanism appeared to be precipitation due to the action of calcium hydroxide, which caused the removal of base-metal cations, as well as the anions $(\text{AsO}_2)^-$, $(\text{AsO}_4)^{3-}$, $(\text{SeO}_3)^{2-}$, $(\text{SO}_4)^{2-}$, $(\text{PO}_4)^{3-}$, and $(\text{S}_2\text{O}_3)^{2-}$, from the aqueous phase.

It was demonstrated that the anions precipitated as their calcium salts, while the cations precipitated as their hydroxides. The potential of fly ash as a purifying agent for polluted waste waters was tested with mixed Matla fly ash and synthetic solutions containing a variety of

toxic species. The quantitative removal of many of these compounds was observed as a function of the settling rate.

Report M360D

Beneficiation of limestone from Pienaars River, by R.N. Guest. First issued 1988, reissued 1990. 23 pp.

An attempt was made to upgrade samples of limestone from a number of dumps at the Kalkheuvel quarry to $MgCO_3$ and NaK (sodium-equivalent) contents of less than 3,5 and 0,48 per cent respectively.

Processes such as wet gravity separation, winnowing, comminution and screening, and magnetic separation all produced material of acceptable grades from some dumps only. While some dumps produced materials with a low $MgCO_3$ content but unacceptably high NaK values, the reverse was true for others.

It was suggested that some form of sizing or air classification would be the most economical means of treating the dumps. However, because the dumps vary in composition, and because the manner in which their material can be upgraded differs, each dump should be sampled separately. Materials from the different localities can then be tested for their amenability to separation and, once treated, could be stockpiled separately before they are blended into an acceptable product.

Report M364D

The recovery of gold from deposits in the Pilgrim's Rest area, by R.A. Burger. First issued 1988, reissued 1990. 15 pp.

Nine samples of gold-bearing materials from five localities were evaluated for their amenability to heap leaching. After chemical analysis and mineralogical examination, the samples were crushed and screened to give the following size fractions for each of the areas of interest: smaller than 50 mm, between 50 and 1,18 mm, between 8 and 1,18 mm, and smaller than 1,18 mm. The tests performed included rolling-bottle tests (to show the amenability of the material to cyanidation), gravity-concentration tests, and column-leaching tests.

It was found that, in general, the materials do not appear to require any crushing or screening prior to heap leaching since extractions of over 80 per cent were easily and quickly achieved at lime and cyanide consumptions that are well within acceptable limits.

It is recommended that the process route should consist of agglomeration (to bind the fine particles together) followed by heap leaching.

Report M396

Reduction of chromite spinels in iron-chromium-carbon alloys, by R.H. Eric and E. Uslu. Mar. 1990. 33 pp.

The kinetics of the reduction of LG-6 chromite spinels in Fe-Cr-C alloys were studied in the temperature range 1400 to 1680°C under an inert argon atmosphere. The rotating cylinder technique was used, and the rotational

speed of the chromite spinel cylinder ranged from 0 to 1000 r/min.

The melt consisted of 30 to 80 per cent chromium and 2 to 8 per cent carbon. The initial chromium-to-iron ratios of the melts varied between 0,42 and 4,95.

The reduction of chromite spinel was analysed in terms of the decarburization of the metal. It was observed that decarburization increased with an increase in the temperature and the carbon content of the bath. However, decarburization first increased with an increase in the chromium content up to about 50 per cent chromium, and then decreased with a further increase in the chromium content of the bath. Decarburization increased when the rotational speed of the cylinder was increased. The effect of this increase was predominant at the initial stages of reduction. After about 400 r/min, decarburization remained almost constant.

In the early stages of reduction, up to about 30 minutes of reaction time, the liquid-state mass transfer of oxygen was found to be the most likely rate-determining step. The apparent activation energy was calculated to be 84,864 kJ per mole of oxygen.

In the later stages of reduction, the formation of carbides of high liquidus temperature, mainly $(Fe,Cr)_7C_3$, around the chromite-spinel cylinder were pronounced, and the contact between the solid oxide and the liquid metal was hindered. Therefore, solid-state processes would be responsible for the further reduction.

5. New review

● *Diverless and deepwater technology. Advances in underwater technology, ocean science and offshore engineering*, edited by the Society for Underwater Technology. London, Graham & Trotman Limited, 1989. 224 pp. £55.

This volume reviews deepwater exploration and drilling, highlighting the present and prospective technology for deepwater production that may have applications at more moderate depths. As exploration drilling moves into the deeper waters of the continental-shelf margins, the regions of interest begin to overlap with those of great significance to the geologist. Scientific seismology and drilling have yielded valuable knowledge of the structure of these regions, which is reviewed here. Problems of drilling practice specific to hydrocarbon exploration in very deep water are also addressed. A wide range of vessels such as monohulls, semi-submersibles, and TLPs have been proposed for the production of hydrocarbons in very deep water. All have their relative advantages, and techniques such as multiphase pumping or subsea separation can eliminate any requirement for a permanent surface vessel moored in deep water. Diverless methods are now available for the performance of many tasks commonly carried out manually in shallower waters. The various competing and complementary approaches to deepwater production and subsea operation are reviewed, and their more important components are discussed in detail.