

## Book Review

*Sampling in the mineral and metallurgical processing industries.*

London, Institution of Mining and Metallurgy, 1973. 65 pp. illus. £5.

The seven papers presented at a special meeting of the Institution of Mining and Metallurgy held in London in July, 1973, have been brought together under the above title.

(i) The first paper 'Sampling and sample preparation of copper concentrator products' by Dr G. Armstrong Smith deals with sampling for the control and metallurgical accounting of the copper-flotation plant at Nchanga in Zambia. Numerous empirical studies were made of the accuracy of the various procedures used in the sampling and sample preparation of mill feed and products. Each step in the procedure was examined separately, and information is given in the form of standard deviations of the mean copper content for the various steps in sampling, grinding, mixing, sample division, and analysis of the final sample for copper content. The treatment is predominantly practical, but there are sufficient discussions of the difficulties experienced, advice on precautions to be taken, and reference to the principles of sampling to provide an understanding of good sampling practice in a copper mill and an indication of the accuracy of the assay result for any particular sample.

(ii) The second paper is by Pierre M. Gy and is entitled 'The sampling of broken ores: a review of principle and practice'. It is evidently based on previous publications by the author, and reference must be made to them for a complete understanding of the present paper. The sub-title indicates that the paper is a review but, as the references list only the author's publications, it must be understood as a review of the author's own work.

In the part of the paper dealing with principles, sampling errors are broken down into their components and there are explanations of 'sampling model', 'fundamental segregation', and 'rate of flow' errors among others. The most interesting

of these is probably the 'fundamental error', which is an inherent error associated with heterogeneous materials and is the only error that can be estimated from the nature of the material being sampled.

The part of the paper that relates to the practice of sampling describes and illustrates not only the correct, but also the incorrect, equipment and techniques for the taking of samples.

The various parts of the paper add up to a very valuable and general guide to sampling.

(iii) 'Mixing and sampling procedures used at the National Institute for Metallurgy, South Africa' is the third paper and is by J. Levin. It discusses the connection between mixing and sampling, describes several mixing and sampling devices, and gives the results of tests to determine their effectiveness. The paper expresses disapproval of the use of the Jones riffle for the sampling of coarse materials that segregate or of fine materials that create dust. Attention is drawn to the effectiveness of mixing by rolling on a sheet, to the homogeneity of the products of batch grinding, and to the superiority of the rotary type of sampler if it is used under conditions that give a large number of increments. The results of tests on sampling and mixing are of interest, if only because this type of information is rarely published.

(iv) In their paper entitled 'Sampling and evaluation of results of small-scale continuous flotation circuits in non-steady state', the authors, D. Watson, D. N. Collens, M. Devenish, and R. W. G. Compton, describe experiences in the operation of a small continuous grinding and flotation plant. Severe variations were observed in mass flows of the plant products so that estimates of recovery based on assays of the products and their amounts were unsatisfactory. However, assay values were less variable than mass flows, and the calculation of recoveries and concentration ratios from assay values was therefore preferable. The paper discusses reasons for the variability of the plant performance, describes how the magnitude of errors in sampling were estimated, and determines the

effect of the combination of errors on the metallurgical results.

To readers who have not had experience of the short-term variability of plants, the information given in the paper will be disconcerting, but they will derive some comfort from the further information that care and discrimination in the interpretation of the results can lead to satisfactory estimates of the performance of the circuit tested. They may, however, incline to the opinion that experimentation to reduce variability in the operation of a plant is no less necessary than the search for techniques to be used in the interpretation of data that should, but do not, represent steady-state conditions.

(v) The fifth paper in the collection, by R. C. A. Barrington and J. Powell, is entitled 'Practical aspects of sampling consignments of iron ore', and discusses problems and methods very different from those dealt with in the preceding papers. The essential question is how to obtain a representative sample from a quantity of material that may exceed 100 000 tons in mass and that may vary in particle size from 250 mm to fines, with the added difficulty that the sampling process must in most instances be done in the short time during which the material is transferred from a ship, for example, to a stockpile. Mechanical systems of sampling and sample preparation are described, but the authors are suspicious of them: they are very expensive, mechanically unreliable, and cannot be used for the sampling of lump ore, which may contain fragments of up to 250 mm in size. Manual methods will therefore continue to play an important part in most sampling systems, even if they are used only to complement mechanical methods. No indication is given of the accuracy of the samples obtained by the procedures described, and it is probable that such information is difficult to obtain because of the nature of the material dealt with.

(vi) 'Sampling in a primary aluminium reduction plant' by J. D. Hamilton is the sixth paper in the collection, and is another practical and descriptive paper. It describes

briefly the manufacture of aluminium in an electrolytic reduction plant and, in some detail, the sampling procedures used for the quality control of raw materials, intermediate products, and final products, and for the pollution control of waste products. A feature of most of the sampling operations is that they concern materials (e.g., alumina and petroleum coke) that are of high purity and homogeneous composition, so that the sampling methods are relatively simple and small amounts of sample are taken from large batches of material by manual methods. Of special interest to those who are normally concerned with the sampling of ores and concentrates are the methods used for the sampling of coal-tar pitch (by a heated ladle), bagged materials such as cryolite (by a specially designed sampling spear), molten electrolyte at a temperature of 975 °C (by sampling tongs), and molten aluminium (by an open ladle). Other materials that have to be sampled and analysed include anodes, flue gases, alloys, the discharge from roof louvres, grasses growing in adjacent fields, bone sections from animals grazing in the neighbourhood, and the urine of plant personnel.

(vii) The seventh and last paper in the collection has the title 'Establishment and control of the sampling procedure for bulk materials' and is by Kaoru Ishikawa. It discusses some of the factors that must be taken into account in the preparation of standard sampling procedures, and summarizes the standards established by the Union of Japanese Scientists and Engineers, with special reference to iron ores. Some of the Japanese standards are compared with the corresponding international standards (I.S.O.), and small differences are observed. Attention is drawn to the need for the checking of sampling and preparation methods from time to time to ensure their continued accuracy; the procedures for checking are described in both the Japanese and international standards.

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The seven papers comprising this publication cover a wide range of topics, and the sampling problems encountered in most metallurgical operations could be related to the information given in one or other of the papers. Metallurgists in South Africa would probably think that papers on sampling in diamond concentration and in gold extraction

could have been justified because of the distinctive problems encountered in these fields. Another topic that would have been of interest is the continuous sampling of pulp for on-line analyses. (Periodic sampling of a pulp stream is mentioned briefly in two papers, and a passing reference to sampling for on-line analysis is made in another.)

The importance of mixing as a component of sampling is shown in three of the papers presented, and the difficulties created by variations of the feed are described equally frequently. This suggests that increased attention to the mixing and blending of mill feed might be advantageous, and that a paper on this topic may have been a stimulus to the consideration of the possible benefits to be derived from the more extensive application of *ore blending*.

Readers of the papers will come across procedures and techniques that may invite questions or discussion, and it may be that many of these points were raised at the meeting at which the papers were introduced. It is felt that the inclusion of the discussion with the papers could only have added to the value of the very informative publication.

J.L.

## Notices

### COMPETITION FOR STUDENT MEMBERS OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY

Each year the Institute offers a prize (or prizes should the entries warrant it) of up to R100 for the best paper or dissertation on a topic appropriate to the interests of the Institute. The competition is open to all Student Members of the Institute.

A Student Member who is in full-time study at a university may submit the dissertation or thesis he has to write in part fulfilment of his university degree, provided that it is presented in a manner and on a topic suitable for publication in the Journal.

Entries for 1973 should reach the Institute by 31st December, 1973.

### APPLICATION AND PRACTICAL OPERATION OF HYDROCYCLONES

Dr H. F. Trawinski of Amberger Kaolinwerke, Hirschau, West Germany, gave a very interesting lecture on this subject to an audience of over one hundred, composed largely of members of the Institute, on 15th August, 1973, at the University of the Witwatersrand. This was a very practical, down-to-earth account of the application and operation of hydrocyclones, with some very clear and explicit illustrations of the dangers that may arise through ignorance of some of the principles involved in the operation.

Possibly the most interesting feature of the talk was the account

of the development of the spider grouping of small cyclones, which results in efficient separations at very small particle sizes.

### ROTARY INTERNATIONAL

Applications are invited before 15th March, 1974, for the following awards of The Rotary Foundation:

- Post-graduate Fellowships
- Under-graduate Scholarships
- Awards for Technical Training
- Awards for Teachers of the Handicapped.

Awards are for *overseas* study and will cover the period September 1975 to June 1976 (or, in the Southern Hemisphere, the calendar year 1975).

Awards cover all costs of tuition, board and lodging, and travel, and each is worth approximately R4500.

Relatives of Rotarians are not eligible. Enquiries may be directed