Book Review

Mining of massive orebodies*

MASSMIN 92 edited by H.W. Glen. Johannesburg, The South African Institute of Mining and Metallurgy, 1992. xiii, 485pp. ill. 30 cm. (SAIMM Symposium Series S12). Includes bibliographies. ISBN 1-874832-18-8. R342 (Member R285; Student Member R218,88. Available in Australia from the AMF Bookshop, 63 Conyngham Street, Glenside, SA 5065 at $A171.00 (approx).

This volume is the twelfth in a series of symposia published by The South African Institute of Mining and Metallurgy since 1962. This particular meeting addressed the subject of the underground mining of massive orebodies. K.C. Owen was Chairman of the organizing committee, and the papers were edited by H.W. Glen. Twenty-nine mining companies, or major companies servicing the mining industry, sponsored the symposium. Fifty-seven papers are included in the volume, classified into eight sections. These sections are planning and design; geotechnical support; infrastructure and access; mining methods; drilling and blasting; production management; selection and maintenance of equipment; and a special section on coal mining.

The papers presented originated in many of the major mining countries of the world, including South Africa, Australia, USA, Canada, Zambia, and Chile, and covered a variety of materials, including gold, diamonds, base metals, and coal. The symposium Chairman points out in the foreword that, despite the economic difficulties of the eighties and nineties, mining engineers have improved their performance. He mentions the increased use of computers in geostatistical modelling, analysis of stress redistribution, design of excavation support, simulation of ore flow, and management of massive mines. Increased mechanization has raised productivity and reduced costs, but has also imposed the need for rigorous techniques of equipment selection and maintenance philosophies.

In the planning section, examples are taken from the 3000 copper orebody at Mt Isa, the adoption of block caving at Kimberley Mines, the Phikwe Mine in Botswana, and the Broken Hill orebody in South Africa. The planning of the closure of the Prieska Copper Mine is perhaps typical of problems today in that they had to comply with ten Acts addressing environmental legislation.

Ten papers on geotechnical interests, including mine support, are indicative of the amount of work being done in this area. As design techniques improve, the percentage of orebodies extracted continues to rise. The papers address panel caving, room-and-pillar working, hydraulic backfill, and design of compound rings. The paper by J.D.P O'Donnell Sr of INCO is especially important. It describes destressing of pillars by blasting to control rockbursts.

Three papers address mine access. One from Australia, by S.G. Gemell and others, draws examples of bulk-mining techniques from Mt Charlotte, Bounty, Golden Grove, and Woodcutters mines.

The nine papers on mining methods commence with a description of the 1100 copper orebody at Mt Isa, which has now been producing for twenty-five years and has experienced several changes in mining methods. Other mines described include Mindola in Zambia and Teniente in Chile.

The five papers on drilling and blasting include a general paper from A. Scott of the Julius Kruttschnitt Mineral Research Centre in Brisbane, and others feature ring blasting and longhole blasting.

The papers on production management all pay attention to the monitoring and improvement of some particular problem, such as wear in drawpoint brows, despatch of production machines, and footwall drawpoint caving.

The papers on equipment selection cover either specific items such as crushers and conveyors, or discuss a 'holistic' approach to the maintenance of mine equipment.

The final section on coal has fourteen papers, all from South Africa. These address many topics from wire ropes through mining methods to methane drainage and site rehabilitation. They give a broad view of the technological status of coal mining in that country.

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Pollution-control measures*

The Department of Water Affairs and Forestry is to implement pollution-control measures in the Loskop Dam catchment. Initial studies and investigations, which have led to the planning and design of two water-treatment plants for the purification of acidic mine effluent in the Klipspruit catchment near Witbank, have reached the stage at which the construction of one of the plants can start in January 1994.

In addition to the R1,5 million available from January to March 1994, an average of R5 million per annum will be spent on the construction of the two plants over the next three years by the Department of Water Affairs and Forestry.

Extensive mining operations over the years have resulted in a deterioration in the quality of both the runoff and the groundwater in the Klipspruit catchment, which constitutes the major source of pollution to the downstream Loskop Dam. This river is acidic, with high concentrations of dissolved metals and salts as a result of the effluent emanating mainly from abandoned mines.

To limit the pollution of the country's scarce water resources, the State has assumed responsibility for providing

* Issued by the Water Affairs Branch of the Department of Water Affairs and Forestry, Private Bag X313, Pretoria, 0001.

pollution-control measures at mines that were abandoned prior to 1956. The Department of Water Affairs and Forestry is responsible for implementing these measures.

The rehabilitation measures in the Klipspruit will, in terms of White Paper (F-92), which was submitted to Parliament in 1992, be undertaken in the following three phases.

- In Phase 1, which is already under way, further exemption from effluent standards will be withheld, and existing permits to industries and mines in the area will be re-assessed.
- Phase 2 will concentrate on the treatment of acid mine effluent in the catchments of the Brugspruit and the Blesbokspruit, both tributaries of the Klipspruit. A water-treatment plant is to be constructed in each of these two catchments to treat polluted seepage and adit discharge emanating from the Transvaal and Delagoa Bay and the Old Douglas collieries (Brugspruit catchment), and form the Middelburg Steam and the Tavistock collieries (Blesbokspruit catchment).

  Construction of the Brugspruit plant is scheduled to begin in January 1994, and it should be operational by the middle of 1995. It will consist of a collection system in which a daily average of 2500 m^3 of acid mine effluent will be conveyed by 8 km of pipelines to the treatment works. A lime-neutralization process will be used to treat the effluent. Approximately half of the treated water will be returned to local industries for re-use, while the remainder will be released into the Klipspruit.

  The Blesbokspruit plant will be similar, but will have a smaller capacity, treating approximately 1000 m^3 daily.

  The Department's Hydrological Research Institute has established a water-monitoring network in the area in order to evaluate the success of the control measures being implemented.

  The total cost of this phase, including the planning, design, and construction of the two plants, will be in the region of R17 million.
- Phase 3 is aimed at achieving certain specified long-term water-quality objectives by the possible re-mining of the remaining underground coal reserves, the stabilization of subsided undermined land, and the total rehabilitation of the surface.

Recovery of settleable solids*

It is well-known that the flocculation of ore containing values is not always a totally efficient method of recovery and separation of settleable solids, and the Alstar–Gravitator, manufactured by Alstar Engineering Limited of Birmingham, has proved its efficiency in the recovery of iron oxide from the final flocculant before the latter is discharged and disposed of.

The Alstar–Gravitator is a unique three-phase separator for liquids, solids, and floating materials, and is designed to remove floating and settleable solids simultaneously.

The solution to be clarified is pumped to the influent connection of the Alstar–Gravitator. The specially designed internal piping leads the influent to the bottom centre of the vessel, which is available in various sizes and models from 10 to 100 gallons a minute, imparting an initial downward velocity to the settleable solids. The flocculated water then rises to the top of the vessel, where collected oil or other floating materials can be removed periodically or continuously through two static skimmer lines, while the recovered settleable solids are discharged intermittently or on a continuous basis. As many as 20 units can be installed in tandem to cope with any capacity.

The economics of the system depend on the value put on the recovered solids or ore. A mining group that evaluated the system for the recovery of iron oxide, established that an entire plant to process 6500 gallons per minute of flocculated liquid before its disposal, will recover the cost of the Alstar–Gravitator plant in less than six months from the value of the recovered product, which would otherwise have gone to waste.

For gold, silver, lead, copper, cadmium, cobalt, tin, zinc, uranium, iron oxide, diamonds, and any other elements that require flocculation and flotation as the process for separation, there is now an additional, cost-effective method of recovery before flocculation liquid containing values that cannot be flocculated is disposed of.

* Issued by Alstar Engineering Limited, Charterland House, 2251 Coventry Road, Sheldon, Birmingham B26 3NX, England.