

SPOTLIGHT

on research into minerals processing

by J.S.J. VAN DEVENTER* and C.T. O'CONNOR†

The fifth University of Cape Town (UCT)/University of Stellenbosch (US) Minerals Processing Symposium was held at the Faculty of Engineering, University of Stellenbosch on Friday, 8th August, 1986. This series was initiated in 1982, the symposia being held alternately in Cape Town and Stellenbosch. The South African Institute of Mining and Metallurgy has kindly agreed to sponsor this event for the next three years.

Research students at the two universities were given the opportunity of defending their projects and research results before a critical audience from industry, which included their sponsors. Consequently, the papers did not necessarily present final results. Many events are organized in which completed work can be communicated, and it is felt that this Symposium offers a much needed forum for closer interaction between industry and academia. Therefore, it is not surprising that the 13 delegates from Cape Town and 8 from Stellenbosch were complemented by a contingent of 29 delegates from industry and 10 from Mintek and the CSIR.

Opening

Mr H.E. James, President of the Institute, formally opened the Symposium and explained why the Institute had become a patron of this annual event. In his address, he discussed strategies by which South Africa can maintain its competitive edge in world mineral markets in a political climate in which disinvestment and sanctions have become a hard reality. He did not believe in the

short-term solutions offered by the circumventing of sanctions, but suggested the development of new technology and production ventures to export value-added metallurgical products. For these and other reasons, more talented young people of all races should be encouraged to enter the mining and metallurgical profession.

Keynote Address

The keynote speaker was Dr N.A. Barcza, Director of the Pyrometallurgy Division at Mintek, who gave a detailed and profound presentation on the role of pyrometallurgy in the South African minerals industry. He explained, not only the different unit operations, but also thermodynamic and kinetic considerations. During a review of pyrometallurgical applications in the production of gold, platinum-group metals, iron and steel, ferrochromium, manganese, vanadium, and titanium, he pointed out that South Africa's foreign-exchange earnings in 1985 followed a relationship directly related to the nobility of these major metals. Dr Barcza indicated the possibility of treating refractory arsenic ores by smelting leached calcine residue, which contains some 15 g of gold per ton. A discard slag with less than 1 g/t gold can be produced when metallic iron is used as a collector phase for gold.

Dr Barcza stated that, although South Africa is a world leader in the application of new technology for steel production, the R & D is done mainly by the steel-producing giants overseas. He emphasized the potential of large-



Left to right: Dr B.K. Loveday (AARL), Dr N.A. Barcza (Mintek), Dr J.S.J. van Deventer (US), Mr H.E. James (at the time President, SAIMM), and Professor C.T. O'Connor (UCT)

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Left to right: Mr H.W. Scriba (US),
Mr P.R. Visser (US), and
Dr J. Chopra (Mutende, Zambia)

scale plasma furnaces for cost reduction when compared with conventional technology. In this regard, Mintek is currently developing a thermal-plasma route for the production of high-grade magnesium by the reacting of dolomite with ferrosilicon.

First Session

The first session, chaired by Dr J.S.J. van Deventer (US), dealt with hydrometallurgy.

Mr P.F. van der Merwe (US) described the mechanism by which gold and silver cyanides are adsorbed onto activated carbon. The level of dissolved oxygen could influence this mechanism and also has a significant effect on the equilibrium. These aspects have to be considered in the modelling of the desorption of gold from loaded carbon.

Professor G.S. Hansford (UCT) presented the results that he and Miss M. Drossou had obtained on the bacterial leaching of pyrite. Electron micrographs illustrated clearly how the bacteria had tunnelled into the pyrite particles. Similar electron micrographs had been obtained in the acid leaching of pyrite. The importance of a sound leaching model for the design of bacterial-leaching reactors was emphasized.

The last presentation before tea was by Mr H.W. Scriba (US). He outlined the selective leaching of base-metal sulphides in chloride medium and discussed the measurement of galvanic interactions between such sulphides.

Second Session

Dr J-P. Franzidis (UCT) chaired the second session, which included five papers on the flotation of pyrite.

Miss A. Dimou (UCT) spoke on the role played by a homologous series of xanthates in the flotation of a synthetic mixture of pyrite and quartz. She discussed the effects of pH, extent of oxidation of the ore, particle size, and concentration of collector. Adsorption studies had shown that, the longer the hydrocarbon chain, the more rapid the adsorption onto pyrite.

In the second paper, Dr J.S.J. van Deventer (US) showed how an air-sparged hydrocyclone had been used to obtain sulphur recoveries of 90 per cent and sulphur grades of 40 per cent during the flotation of a coarse Ergo residue. A spigot of improved design had prevented blockage of the cyclone by wooden chips. Due to shear forces, the additions of collector had been three times as high as in conventional flotation.

This was followed by a paper by Mr T.P. Hanekom (US) on the characterization of frothers used in the flotation of pyrite. He explained the use of different froth heights and sampling in froth columns as techniques for the measurement of froth stability, drainage, and entrainment. Very little correspondence had been observed between the behaviour of two- and three-phase froths.

Professor C.T. O'Connor (UCT) discussed the role of copper sulphate in the flotation of pyrite. The major effect of copper sulphate appears to be in the froth phase. The copper sulphate affects the hydrophobicity of the pyrite. At low dosages, this causes an increase in pyrite recovery. However, it was proposed that, at high dosages, the contact angle increases to the extent that bubble coalescence in the froth phase is enhanced, the end result being a decrease in pyrite recovery.

The last paper of the morning was by Mr C. Goodall (UCT), who had recently started work on froth-phase phenomena. He described the equipment he had developed to enable the froth phase to be sliced off into segments instantaneously and then analysed for particle size, water, solids and air recovery, and grades. He presented preliminary results indicating that, for pyrite, coarse particles were at the top of the froth and fine particles at the bottom. This effect was reversed for pure quartz and pyrophyllite.

Third Session

The first session after lunch was chaired by Professor G.S. Harrison (US).

In a stimulating change from flotation, Mr P.R. Visser

(US) discussed factors that influence the rheology of coal-water mixtures. He showed that the particle-size distribution and the zeta potential are the most important influences on stability and rheology. A good coal-water mixture is a compromise between these characteristics. Different coals behave differently owing to their ability to adsorb water and to their surface composition.

The liberation characteristics of five Witbank export coals, and Greenside coal in particular, were presented by Mr M.C. Harris (UCT). The main conclusion of this work was that an increase in the extent of comminution of the coal to a particle size of 25 μm did not markedly enhance the degree of liberation of the coal.

Mr V.E. Ross (US), who presented the final paper before afternoon tea, discussed mass transport phenomena in flotation froths in a humorous way. He explained how the fluid mechanics in different cells could be incorporated with flotation kinetics in the pulp and mass transport in the froth phase. A mathematical model developed for this purpose was shown to give surprisingly good predictions. He described the ultimate objective of the project as the development of an effective scale-up procedure.

Fourth Session

Professor C.T. O'Connor (UCT) chaired the final session of the day, which dealt with the flotation of coal.

Mr R.S. Fickling briefly reviewed the results he had obtained in a study on parameters in the flotation of four different South African coals. He showed how he had used a factorial design method in attempting to unravel the complex interactions that exist in coal flotation. This was an extensive investigation and represented in many respects a first attempt to quantify the flotation behaviour of South African coals.

He was followed by Mr H. Fourie (US), who discussed the work he had started recently on the effect of froth stability on the flotation of South African coals. He ex-

plained how he envisaged correlating a stability parameter with a selectivity index.

The final paper was presented by Mr G.V.M. Anderson (UCT). He discussed the micro-scale performance of hydrocarbon oils in the froth flotation of coal fines, with particular emphasis on their availability to the coal (dispersion) and their adsorption kinetics. He showed that conditioning procedures and the consequent influence on oil dispersion within the pulp have a marked effect on the overall flotation performance. Moreover, adsorption of the oils is rapid and has no effect on the rate of flotation.

Conclusion

Summing up the proceedings, Dr B.K. Loveday, Manager of the Anglo American Research Laboratories, said that the quality of the presentations was what one could expect from the centres of excellence at the two universities. He encouraged the different approaches of the three research supervisors, i.e. Professor C.T. O'Connor (UCT), Dr J-P. Franzidis (UCT), and Dr J.S.J. van Deventer (US), and observed that each approach was systematic and novel. Above all, he treasured the spirit of enthusiastic collaboration that exists between the two neighbouring universities. Dr N.A. Barcza (Mintek) was specially congratulated on his stimulating keynote address.

Professor G.S. Harrison (US) thanked the delegates in a delightful manner for their interest in the research at the two universities, and formally closed the Symposium.

Acknowledgements

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Cokemaking

On the initiative of the European Cokemaking Committee, the First International Cokemaking Congress will be held in Essen (F.R. Germany) from 13th to 19th September, 1987. It is being organized by the Steinkohlenbergbauverein, together with the Verein Deutscher Eisenhüttenleute.

The Congress will consider the future prospects of long-term blast-furnace coke supplies to the iron and steel industry, and will give experts from all over the world an opportunity for an intensive exchange of ideas.

Experts on cokemaking technology are invited to contribute papers on any of the following subjects. Prospective authors are asked to submit titles and abstracts in German, English, or French.

- Conditioning and pretreatment of coking blends to widen the coal base and to increase homogeneity of coke-oven charges with simultaneous utilization of high production rates
- The carbonizing system:
 - New findings on the carbonization process

- New carbonization systems
- New developments in coke-oven design
- Process monitoring and control
- Safety and health at work and environmental protection
- Demands on developments in cokemaking technology
- The behaviour of coke in blast furnaces
- New developments in gas treatment and byproduct recovery
- Improvement in energy economy:
 - Energy saving and recovery
 - Increase in thermal efficiency of coking plants.

Further information is available from the following address:

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