

SPOTLIGHT

on flotation

by JOHN FREER*

Over 200 delegates attended the SAIMM Colloquium on Flotation, which was held at Mintek on 22nd September, 1983.

In introducing the programme, the Chairman of the Technical Programme Committee, Mr Eugene Fivaz, said that an attempt had been made to strike a balance between theoretical and practical papers, which he hoped would provide something for everyone. He wished to record in advance the thanks of the Institute to S.A. Cyanamid for sponsoring the lunch, and to Bateman Equipment Limited for the cocktail party to be held at the end of the day's proceedings.

The President of the Institute, Professor Peter King, opened the proceedings and noted that flotation was far from a simple operation. He predicted that difficult coal and mineral deposits in South Africa would continue to challenge South African research in the Departments of Chemical and Metallurgical Engineering in universities, institutes, and the private sector for many years to come.

Professor King pointed out that universities were poorly supported in South Africa compared with other countries, and compared with institutions such as the CSIR and Mintek. The State would be funding general research at universities for the first time in 1984, and he hoped that industry would follow this lead since there was not much direct sponsorship of research at universities at the present time.

He appealed for papers presented at this and other colloquia to be submitted for publication in the Institute's journal, but stressed that, as papers presented at colloquia were not necessarily designed for publication, the Institute would welcome extra effort on the part of authors to get their manuscripts up to the requirements of the *Journal* and he urged them to do so.

The President then declared the colloquium open, with good wishes for a most successful day.

First Session

The first session, under the chairmanship of Alan Haines, was devoted to flotation of pyrite and gold in the gold-mining industry.

Dr Cyril O'Connor gave a stimulating presentation of the results of research sponsored by Mintek and carried

out by Miss A. M. R. Botelho de Sousa for her master's degree at the University of Cape Town into *the effects of temperature on pyrite flotation*. It was shown that temperature has no significant effect on the final recovery but a marked effect on the rate of flotation.

In a complementary paper, Tony Stephens reported on the correlation of air temperatures and pulp temperatures at three flotation plants in the Orange Free State, and the drop in pyrite grade of the flotation concentrate, which had first been recorded in the winters of 1978 and 1979. By slowing down the rate of treatment when the temperature dropped, they had found that it was possible to achieve the required grade at the expense of sulphur recovery. The work reported in this paper was being followed by a financial feasibility study of the cost of using steam to heat the pulp in winter to maintain design production rate and grade.

The practical point to come out of these two papers was the importance of determining the effect of temperature when new ores or new reagents for flotation were being tested.

Dr Allison of Mintek compared results of *pyrite and gold flotation on a number of plants and circuits* on the East Rand, West Rand, and O.F.S. for the retreatment of dump material and for run-of-mine ore, as well as the results of some fundamental laboratory studies. Many interesting data were included in the paper, which warrants close study by parties interested in this field or thinking of undertaking the retreatment of dumps. He and his co-authors concluded that gold recovery in the fine size range could be as high as 80 per cent in plants treating milled ore, but the lower recoveries from tailings could be attributed to the smaller percentage of free gold present. Also, the rate of gold and pyrite flotation was greater from plants treating coarse milled ore than from those treating tailings.

Dr Hinde of the Chamber of Mines Research Organization presented *work on the design and scale up of the Chamber of Mines' cell*, which was part of their continuing programme on the recovery of a gold flotation concentrate underground. Flotation would be one of the keys to the process, but this would have very stringent limitations such as the wide range of particle size in the feed, from greater than 1 mm down to slimes, the small size of the cell and hence the need for fast kinetics, and the need to recover slimes and so eliminate them from the tailings that would be used as backfill. He concluded that these objectives had been met, and that the performance of this cell for the purposes for which it had been intended compared favourably with conventional cells.

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Second Session

Three unrelated papers were presented in the second session, which was under the chairmanship of Dr Brian Loveday.

Eric Verstraete, Product Manager for flotation cells for Bateman Equipment Limited, described the development of *large flotation cells* for high tonnage, low-grade orebodies to get maximum cost effectiveness.

Jimmy Goodey reported on the development of Foskor's *recovery of apatite from the hydro-separator overflow of the tailings at Palabora Mining Company*. They already recovered apatite from the *underflow*. The work had been done over several years in logical progressive stages on their 4 t/h on-stream pilot plant. Plant trials had started in July 1983, and the design parameters had been met within three weeks.

Peter Shaw described a method developed for the *characterization of flotation frothers*. The method was a useful empirical tool for investigational laboratories, using a well defined aqueous solution of frother in the absence of any solids and a standard laboratory flotation machine, to get a better understanding of what a frother was doing. The only parameters measured were the volume and rate of solution overflow with variations in ionic strength, pH, temperature, gas flowrate, etc. Some interesting comparative graphs were presented. Some of the effects described would be 'swamped' by the characteristics of the minerals if ore were present in the system. Without the ore, it was possible for the underlying characteristics of the frother, which were real and important, to be discerned.

Third Session

After lunch, in the third session, which was devoted to coal and was chaired by Eugene Fivaz, Professor King gave a stimulating presentation of a paper prepared by Mr G. Panopoulos, one of his post-graduate students, *on the effect of particle-size distribution on the flotation of fine coal*. The flotation characteristics of two South African coals had been investigated, neither of which had been found to produce satisfactory concentrates except at very fine sizes. This was ascribed to the non-selective flotation of unliberated particles containing quantities of ash. The investigation gave a very clear indication of what was happening with 'non-floatable' fine coals, and showed that, for anyone to make any headway with flotation in coal beneficiation, he would have to grind to finer sizes and try again in the slimes range. Some success was being gained, and this pointed to the use of the dense-medium hydrocyclone for the coarser fractions and of flotation for the ultra-fines.

Mr P. Venter summarized a very full, four-part paper that he and his co-authors had prepared covering the wide field of the *design, erection, and commissioning of the froth flotation section of the Grootegeluk coal-preparation plant*. The whole plant treats 3000 t/h of raw coal to produce a coking fraction at 10 per cent ash and a middlings fuel coal. About 400 t/h of minus 0.5 mm coal was subjected to froth flotation, which had been selected as

the favoured method after it had been tested together with shaking tables, heavy-medium cyclones, and water-only cyclones in combination with flotation. The test-work had been extended to permit the selection of the equipment most suitable for this coal and the rest of the plant. Several operational problems had been encountered during the commissioning, and the work done to indicate the best solution was also discussed.

Fourth Session

The final session of the day, chaired by Dr Ian Corrans, was devoted to two papers concerning the complex sequential sulphide flotation of copper, lead, and zinc at Black Mountain.

The first, *on the interactive effects of the sulphite ion, pH, and dissolved oxygen on the flotation of chalcopyrite and galena*, investigated by batch tests, was presented by V. E. Ross, a Mintek bursar working at the University of Stellenbosch. He concluded that the recoveries of copper and lead were sensitive to the amount of sulphurous acid or sodium sulphite added, the milling conditions, and the degree of pre-aeration. The paper bore the stamp of a logical and disciplined approach to a scientific investigation that was to be expected of a post-graduate student.

The final paper of the day came from Timothy Twidle, Plant Superintendent at Black Mountain, and dealt at length with *the developments in copper flotation at Black Mountain*. It compared the poor initial plant performance with the design expectations, which had been based on earlier pilot work, and led on to a comparison of plant performance with repeated pilot studies and the implementation of the corrective measures that had been found to be necessary.

Conclusion

In summary, the delegates were treated to a wide variety and wealth of information and experiences in the field of froth flotation. Having had the privilege of preparing this Spotlight, I found that the following two points came out most strongly.

- (1) It is important, not only to go through colloquium papers before they are presented to get maximum benefit while the author is making his presentation, but also to go through them again afterwards to consolidate at least those areas of personal interest.
- (2) These papers contain a wealth of material that would be suitable for publication in the *SAIMM Journal* but, as our President said in his opening address, this material is not always in a form suitable for publication as it stands. Just as the audience should put in the extra effort to absorb and understand the problems as described above, so should the authors reinforce the effort they have already put in by reviewing their texts and making them conform to a standard that would do credit to their Institute and to themselves.

All-in-all, it was a most interesting, valuable, and successful colloquium from the points of view of the delegates, authors, and organizers alike.