Modifications to the coal-preparation circuit at the Grootegeluk Coal Mine to improve its efficiency

by P.E. Venter and C. van Loggerenberg*

CONTRIBUTION BY P.J. VAN DER WALT†

The paper covers a wide range of modifications that are of potential interest to the practical coal-preparation engineer. Unfortunately, the paucity of performance data does not permit one to draw conclusions.

The authors do not appear to have a clear understanding of the Tromp (or partition) curve concept.

In Table II and Figure 7, the Epm values are reported to be slightly above 0,01 RD. This order of magnitude is surprisingly low for a commercial plant operating at high density. When Figure 7 is examined more closely, it is noted that the difference between D25 and D75, in each case, is in the region of 0,11 RD. By definition, the Epm is half this value, at 0,055 RD. This figure may be far less impressive but *is* more realistic.

The authors draw the conclusion from Figure 7 that 'no dramatic drop in the efficiency occurs at the higher densities'. It will be noted that the left-hand curve is severely distorted, while the right-hand curve is substantially normal. In other words, the separation at the higher cutpoint was, in fact, much sharper (and, hence, more efficient) than that at 1,66 RD. If separation at 1,66 RD had been normal, one could estimate from Figure 6 that the organic efficiency would have been about 98,6 instead of 97,4 per cent.

It is not clear whether the data in Table II and Figure 6 refer to the same tests. If they do, then there is a discrepancy in the percentage yields given. If the data are not comparable, this should have been stated.

REPLY BY P.E. VENTER

We have the following to say with regard to the comments made by Dr Van der Walt.

- Firstly, we would like to use this opportunity to invite Dr Van der Walt to visit Grootegeluk to witness the magnitude of the improvements made on this plant. The paucity of performance data was due to the fact that the paper describes some 18 projects covering a wide range of mineral-processing activities in a restricted amount of space. However, details of these projects are available, and the authors will provide Dr Van der Walt with more data if he so wishes.
  The purpose of this paper was to stimulate awareness of the potential for improvement that always exists in coal-preparation plants. Clearly, we have succeeded in doing so, judged from Dr Van der Walt's comments.
- Dr Van der Walt makes the statement that we do not have a clear understanding of the Tromp (or partition) curve concept. It seems to us that even Dr Van der Walt seems to be uncertain whether a Tromp curve is a partition curve or not. The authors would like to mention that Grootegeluk has developed a model to simulate the Wolf and Tromp partition curves, and have used this model to simulate screening partition curves. We refer Dr Van der Walt to a paper entitled 'The use of simulation Tromp partition curves in developing the flowsheet of plant extensions at Grootegeluk Coal Mine' by T. de Lange and P.E. Venter, which appears in the proceedings of Apcom 87 (published by the SAIMM in 1987: vol. 2, pp. 295-311). We invite his comments on that paper.
- Dr Van der Walt states that we achieve surprisingly low Epm values for a commercial plant, i.e. in the range 0,010 to 0,015 RD. We at Grootegeluk are proud to say that we actually do achieve Epm values within this order of magnitude.
  We have two cyclone plants in operation, i.e. a primary cyclone plant (higher density cutpoint) and a secondary cyclone plant (lower density cutpoint), where we achieve Epm values of about 0,015 and 0,018 RD respectively.
  To elaborate on the excellent results, we refer Dr Van der Walt to Table I, which shows results from our primary cyclone at varying cutpoint densities.
  These tests were conducted on the primary cyclone plant during 1988, and indicated that the Epm values

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Table I

Tromp cutpoint, d_{50}	1,92	1,836	1,792	1,751	1,772	1,850	1,67
Wolf cutpoint	1,907	1,794	1,782	1,747	1,788	1,777	1,69
Mayer cutpoint	1,912	1,809	1,790	1,753	1,789	1,826	1,689
Near density, %	5,47	2,90	6,57	5,02	8,32	6,74	12,27
Epm	0,022	0,008	0,020	0,010	0,007	0,012	0,007
Misplacement	1,13	0,75	1,87	1,39	0,88	4,04	1,56
Org. efficiency	99,79	99,52	99,60	99,57	99,98	96,94	99,69
d_{75}	1,897	1,828	1,772	1,741	1,765	1,832	1,660
d_{50}	1,92	1,836	1,792	1,751	1,772	1,845	1,668
d_{25}	1,941	1,844	1,812	1,760	1,779	1,856	1,675

could be expected to increase with increased cutpoints. To enable us to evaluate the impact of densifiers on our circuits, we had to make sure that there would not be a dramatic drop in performance efficiency at higher cutpoint densities in the primary cyclone. Tests at higher separation densities were conducted, and Epm values of between 0,011 and 0,020 RD were obtained with cutpoint densities between 1,90 RD and 1,95 RD. The organic efficiency varied between 99,4 and 99,7 per cent at specific float ash values. Tromp efficiencies of about 96,3 per cent were obtained. (We define the Tromp efficiency as the error area divided by the total area—a two-dimensional parameter.)

The reference in the paper to the expected drop in performance at higher densities therefore refers to earlier results at the Mine, and not to the actual results referred to in the Tromp curves. As Dr Van der Walt correctly points out, the performance at the higher densities did, in fact, improve. This improvement can be attributed to a general decrease in the amount of near-density material and to reduced contamination of the circulating medium, which would seem to counter the negative effect of increased volumetric loading of the circulating medium with magnetite at higher densities.

The purpose of Figure 7 was to indicate that no dramatic flattening of the curve takes place at higher separation densities, and therefore there is no real risk of losing performance efficiency at separation densities of the order of 1,94 RD.

- Dr Van der Walt correctly pointed out that the results shown in Figure 7 are not consistent with the data reported in Table II, or the calculated values for Epm reported in Figure 7. These values were calculated by use of a computer program developed by the Mine. Unfortunately, the print-out of this program is not suitable for publication in the *Journal* as a result of poor graphic resolution, and the authors had to make use of a well-known graphic software package to fit the Tromp curve to the actual data points. In this process, the curve lost its actual sharpness, and the calculated values were therefore presented at the bottom of the graph.

  The authors regret that this manipulation of the graph misled Dr Van der Walt, and therefore have asked the Institute to send him all the raw data used in the determination of the Tromp curves. The print-outs of the computer program are included, since we are sure Dr Van der Walt would like to verify the accuracy of the program by manual calculation.

- The run-of-mine material treated at the Grootegeluk I plant consists of material originating from three mining benches in the Upper Ecca. Since the material from two of these benches is normally blended, the authors decided to calculate an average washability curve from the washability data for all three benches.

  This curve was shown in Figure 6 of the paper, and was used in the determination of the overall potential of this project in the long term. The results in Table II are typical densifier operating results obtained during a specific test, and therefore form part of a series of tests used as the basis for the curve shown in Figure 6. The paper clearly points out that Table II refers to typical results, and the authors cannot therefore accept responsibility for Dr Van der Walt's feeling that he was misled.

- It appears that Dr Van der Walt's comments are symptomatic of a situation that exists in some spheres of the coal-beneficiation industry, namely that very much attention is given to micro-detail, while holistic conclusions, which normally lead to higher rates of improvement, are not given enough attention.

  However, the authors thank Dr Van der Walt for his comments, and pledge their assistance in helping him to draw conclusions from the paper.

BRANCH News

Extractive metallurgy laboratory: Vaal Triangle Branch

SHARED LABORATORY

The established shared laboratory facilities between the Departments of Metallurgy and Chemical Engineering of the Vaal Triangle Technikon and the University of Potchefstroom are already proving to be a great success.

Following the concept of the Chamber of Mines almost three years ago, a shared laboratory facility was established at the Vaal Triangle Technikon. Facilities were made possible by funding received from the Chamber of Mines and shared equipment from the two Departments. At that time, Chris Viljoen was appointed to the newly established laboratory, after he had gained his Higher National Diploma at the Vaal Triangle Technikon while employed at Stilfontein Gold Mine. At present, he is studying for his Master's Diploma.

STUDENTS

Over a period of two years, Chris established a laboratory that can handle practical assignments for third- and fourth-year chemical- and metallurgical-engineering students from the University, and from the Technikon in ore preparation. This semester, 51 students are undertaking their practical training in the laboratory, which means that over 300 practical reports will be presented. Over the past two years, more than 700 practical reports were submitted. The practicals enable the students to become operationally familiar with equipment similar to that on the mines. The practicals include the preparation of a practical experiment and the investigation of the cause and origin of a problem.

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