Investigation and Development of Some Laboratory Wet Gravity Mineral Concentrators

L. D. MULLER, B.Sc., M.A.I.M.E., ASSOCIATE MEMBER, and
J. H. POWNALL, A.R.S.M., B.Sc.(Eng.), ASSOCIATE MEMBER

Authors' reply to discussion on paper published in April, 1962* (Transactions, *vol. 71, 1961–62*), *pp. 379–92*

Messrs. L. D. Muller and J. H. Pownall: Dr. C. R. Burch, in opening the discussion, suggested that the acceleration analogue of Reynolds number, and expressed by him as D^3A/ν^2, a pure number, would be of value in considering the motions of particles on concentrator decks. He inquired if the maximum acceleration A could be determined from the original oscillograms. Since the method of measurement used was selected primarily to observe deck displacement rather than acceleration it has not been possible to provide an accurate value of A. Our own estimate, of the order of $4g$, is similar to that of Dr. Burch.

Among the points raised by Mr. H. N. Blyth, and left unanswered, was the suggestion that the water in the tank below the porous deck of the concentrator might well surge, to give uncontrolled pulses, during reciprocation. This surge effect was not observed in the relatively small pulsepanner described in the paper, nor has there been any evidence to suggest that it is present during operation of the porous-deck laboratory-size shaking table at present under investigation.

Mr. J. S. Jacobi, in his written contribution, has made several pertinent comments, in one of which he has queried the use of a closely sized, fully liberated, artificial mineral mixture in preference to the comminuted hydro-sized material normally associated with industrial tabling practice. In making our choice of test material we realized that we were departing from conventional tabling practice but we were primarily concerned to have a test material which could be used in a series of *comparative* tests; a material which was not only closely defined and reproducible (and easy to assay) but also free of any unknown middlings factor which might mask the results of the comparative tests. The second test material used was, in fact, a natural carbonatite which had been crushed and screened and which contained a true middlings fraction. Nevertheless this material indicated an improvement in performance for the various concentrators tested similar to that shown with the quartz-riebeckite mixture. Incidentally, it is not understood why it should be necessary to have a middlings to lend stability to table operation as suggested by Mr. Jacobi.

Though we appreciate Mr. Jacobi's offer, and the interest it denotes, it is not possible, owing to a lack of material, to send him a 20-kg quartz-riebeckite sample so that he may try to improve on the tabling result quoted. In this connection, it may be of interest that recent results obtained with a porous-deck laboratory-size shaking table, and using the same

*Vol. 71, pp. 663–84.

quartz-riebeckite mixture as before, have shown the same kind of improvement due to pulsed operation. We would agree, however, with Mr. Jacobi's further comment that the method of obtaining the table samples described in the paper might conceivably have led to biased results, though it was the only possible method of comparing the table and the batch-operated panners detailed in the paper.

In reply to Mr. I. R. M. Chaston, we agree that the possibility exists that the porous deck surface might well become clogged during operation. There have as yet been no indications of this occurring, however, possibly because the deck is subjected to alternating series of positive pulses and suction strokes which assist in clearing individual pores.

That recoveries appeared to be limited to a maximum figure of about 80 per cent (as in the case of the pulsepanner) may be explained by the fact that beyond this figure it was not possible to recover further viable concentrates of the heavy minerals. It would, no doubt, have been possible to extrapolate the curves (some of which did not even reach the 80 per cent value) to 100 per cent recovery, but this would probably not have been very meaningful.

Mr. Chaston, together with Mr. Blyth and Mr. D. G. Armstrong, has pointed out that the timing of the pulses in relation to the horizontal motions of the deck might well have a considerably beneficial effect. We entirely agree and intend shortly to make a detailed study of the phasing of these two parameters. This problem, though appreciated, was not examined in the work reported in the paper, during which the pulsepanner was normally operated at between 150 and 240 cycles per minute whereas the pulse frequency of the pump was limited, by the simple equipment used, to a constant figure of 60 pulses per minute. A periodicity of movement of the bed of particles along the deck was, in fact, evident though not marked and may well have been an expression of minimum and maximum phasing of these two parameters.

Mr. A. L. Stewart's results relative to the use of heavy liquids to increase the concentration criterion when separating minerals of similar specific gravities in a prospecting pan are of interest. Taggart, in his description of the Haultain superpanner, had suggested this possibility, and the advantages to be gained in using both heavy and 'light' liquids in panning have already been illustrated and discussed.*

In reply to Mr. F. A. Williams, neither the macropanner nor the pulsepanner have as yet been tested using heavy minerals finer than 200 mesh B.S. In respect of the work at present being undertaken at this Laboratory to apply the pulsed deck principle to plant-scale concentrators, it is perhaps too early to state with certainty whether such concentrators would have greater throughputs per unit area of deck, though the present expectation is that this may prove to be the case. It is certainly too early to indicate whether or not the final design of a pulsed concentrator would be adaptable to multi-deck construction.

*MULLER, L. D. The micropanner—an apparatus for the gravity concentration of small quantities of materials. *Trans. Instn Min. Metall., Lond.*, **68**, 1958 59 (*Bull. Instn Min. Metall., Lond.*, no. 623, Oct. 1958), 1–7.