# Recovery by Flotation of Cassiterite contained in Gravity Concentration Plant Trailings

By E. B. VILJOEN

**I. R. M. Chaston***

As a gravity concentration man in the midst of so many eminent flotation experts I feel like Daniel. However, I would respectifully disagree with the opening remarks by Mr Viljoen.

First, he suggested that gravity concentration of cassiterite was not effective in sizes below 30 microns. In a paper to the Institution of Mining and Metallurgy in 1962[1], I gave some figures for gravity concentration of deslimed material both for cassiterite and for wolfram which indicated that careful shaking table concentration of fine deslimed material could give recoveries of 75 to 90 percent in the size ranges above 13 micron. These were figures obtained from normal plant operation. It would be interesting to know if any tests were carried out on gravity concentration of the efficiently deslimed feed to this flotation plant to see what the recovery would be.

Secondly, Mr Viljoen suggested that gravity concentration plants were expensive. He gives the cost of a flotation plant at R300 000 to treat a feed of 400 t.p.d. to the desliming section or 160 t.p.d. to the flotation cells. From his operating cost figures it would appear that the flotation cost is approximately R2 to R4 per ton of feed to flotation and the total operating cost about R2 per ton of feed. A table plant to treat this tonnage of deslimed feed would consist of about 30 tables and should cost considerably less to install and very much less to operate than the flotation plant.

Third, Mr. Viljoen suggests that the concentrate grade from a gravity concentration operation would be unacceptably low. The paper quoted above[1] showed that once a primary fine concentrate had been made, giving a suitably deslimed material, further gravity concentration could give concentrates of over 40 per cent Sn with high recoveries. Tailing from this dressing stage was naturally returned to the feed. To give these high grades, sulphides had been removed by flotation but this necessary flotation step is simple and cheap to operate and could be restricted to the final stage when the quantities involved are small.

I would agree that flotation has a part to play in fine tin recovery but this role would only seem to become fully effective at sizes below 10 micron and would seem to require, as Mr. Viljoen has suggested, a mechanism for sizing which is effective down to, say, 1 micron.

In the meantime it would be interesting to try tabling the flotation tailing to see if it was possible to recover the plus 20 micron cassiterite which is not recovered well by flotation.

One point which has been made during discussion is the suggestion that cassiterite particles have a fully hydrated surface at normal pH. I wonder if this layer could materially affect the overall specific gravity of a very small cassiterite particle and, if so, whether gravity concentration of the very fine cassiterite would be improved if carried out in acid conditions, which would inhibit the formation of this hydrated surface.


REFERENCES

1. Chaston, I. R. M. 'Gravity concentration of fine cassiterite'. *Trans. Inst. Min. and Met.* Vol. 71, p. 4, 1961 and 1962, and discussion of this paper.



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Mr Viljoen has drawn attention to the difficulties associated with the presence of very fine particles in the flotation pulp and he has indicated that, on the Union Tin plant, they must sacrifice 30 percent of the cassiterite in the minus 7 $\mu$m material which they separate and lose. He has also indicated that the rate of flotation of cassiterite remained high at these small sizes. The problem arises because the very small particles stabilize the froth making it impossible to handle. These stable froths cannot be easily broken and therefore cannot be pumped and processed. It seems that further fundamental research work on the properties of stabilized froths is urgently required.

We have found another difficulty associated with the presence of very fine particles in phoscorite slurries; these particles can be easily floated but with very poor selectivity. We believe that it is possible that a purely physical mechanism such as entrainment is responsible for the collection of fine particles in the froth.

We have also demonstrated that the presence of fine particles in the pulp adversely affects the rate of flotation of the larger particles. For esample, we have found an increase in recovery of $+100$ $\mu$m material from 2 percent to 17 percent in a standard laboratory batch flotation test on phoscorite when the $-37$ $\mu$m was removed from the feed. Such interactions between particles are not universally recognised as an important aspect of the complex flotation mechanism. They should appear in any quantitative formulation of the flotation rate process.