A note on predicting the performance of large flotation machines

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The use of large flotation machines is well established, resulting in substantial savings in both capital and operating costs. Therefore, when a new plant is designed, laboratory and pilot-plant tests should be used to simulate large flotation cells, or appropriate scale-up factors should be employed. This necessitates some understanding of the influence of scale and, more particularly, of the effect of less power per unit volume.

A comparison between pilot-plant cells (say 28 litres or 1 ft^3) and typical large cells of 28 m^3 or 1000 ft^3 shows the recovery per unit time to be about the same, despite a tenfold drop in power. However, the surface area per unit volume decreases from 1 to 0,1 (in imperial units). Therefore, in order to keep the same air velocity through the froth[1], *the air flow per unit volume is also reduced by a factor of 10.* However, the air bubbles have on average a tenfold increase in residence time in the pulp, which allows them to collect proportionately more mineral (i.e. all the dimensions are increased by 10, including height).

The nature of the pulp (e.g. coarse particles) and cell design may differ, but in general both power and air per unit volume are inversely proportional to the linear dimension of the cell (cube root of volume). Fig 1 shows data published on the Wemco cell[2]. The increased residence time of the bubbles compensates for this phenomenon, but it follows that bubble loading and the concentration of mineral in the froth are increased in proportion to $(\text{volume})^{1/3}$. The power savings appear to be due to the fact that proportionately less air is required. Power (including the compressor, if used) is proportional to the quantity of air *dispersed.*

The implications of the above are as follows.

(i) It is understandable why the kinetics of froth flotation of low-grade ores are not influenced by scale-up since the bubbles are unlikely to become saturated. However, when the floatable species is a major constituent (e.g. phosphate ore, coal), bubble saturation will occur to an increasing extent as larger cells are used. A constant rate of production of concentrate per unit time will indicate saturation. In this case, more residence time (or air) will be required in the larger cells. It is of interest that the air velocity through the froth has been increased in some of the larger machines, resulting in the use of slightly more power than projected (i.e. a flattening of the curves shown in Fig. 1).

(ii) The more heavily mineralized froth obtained in the larger cells will influence the characteristics of the froth. To simulate this in a small unit, it

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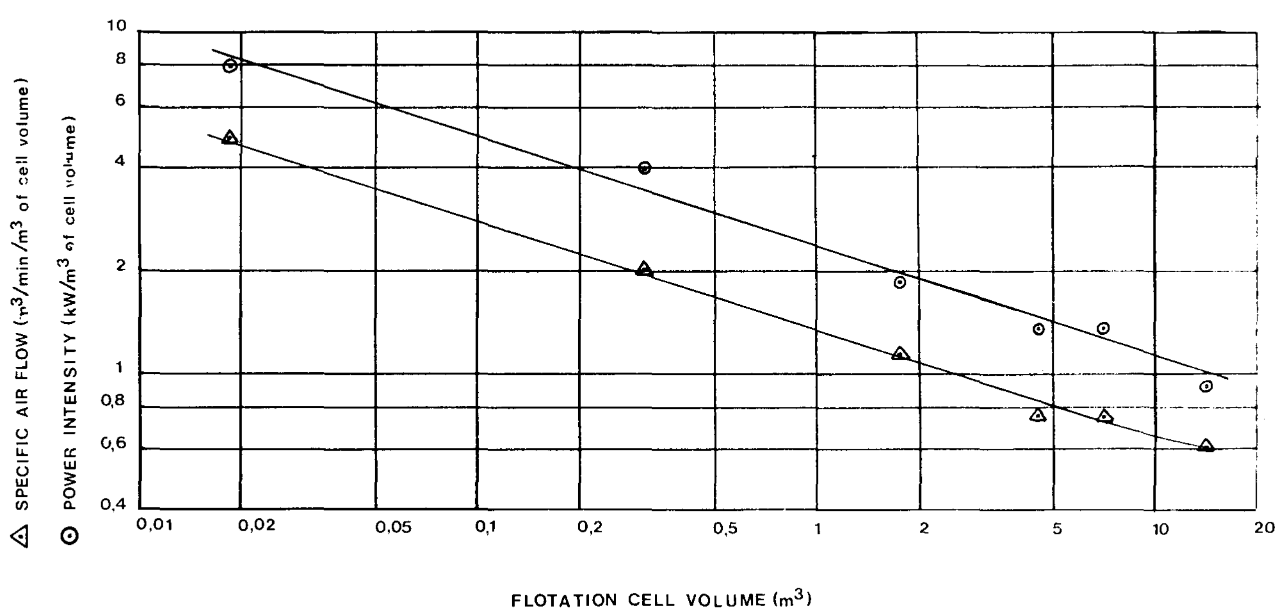

Fig. 1—Data from reference 2 showing power and air per unit volume as functions of cell volume

may be necessary to restrict surface area and increase depth.

(iii) The power required for the flotation of low-grade ores or for scavenging can be minimized by the use of cells with a higher aspect ratio.

References

1. Harris, C. C. Flotation machines. *A. M. Gaudin Memoria Volume*, Vol. 2. New York, AIME, 1976. p. 810.
2. Degner, V. R., and Treweek, H. B. Large flotation cell design and development. *Ibid.*, pp. 816 – 837.

Conference on titanium

The Fifth International Conference on Titanium will be held from 10th to 14th September, 1984, in Munich, West Germany, organized by the Deutsche Gesellschaft für Metallkunde e.V., in association with the American Society for Metals, Sociëté Francaise de Metallurgie, The Academie of Sciences U.S.S.R., The Japan Institute of Metals, The Metallurgical Society of A.I.M.E., and The Metals Society.

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