

in the crystal lattice and consequently has a variety of mineral formulae.

CONCLUSIONS

There are several problems common to phosphate and potash flotation, one of which is the flotation of coarse particles. There must be static equilibrium among the forces which hold a bubble and a particle together and, because the disruptive forces increase rapidly with size, there is a maximum size which can be floated. These disruptive forces increase as the density difference between the solid and the suspending liquid increases. The forces of adhesion increase as the contact angle increases, and that is why it is necessary to know something about wetting.

Another common problem is the identification of the proper extender characteristics. The advantages of using an extender are clear, but how to identify the best extender is not known.

The slime problem is, of course, vexing in both treatment schemes. At the present time the best treatment is to eliminate the fine material as thoroughly as possible. Starches and similar compounds called "blindners" are helpful, but their functioning is not thoroughly understood.

Magnitude of the Industry

The consumption statistics of fatty acids, amines, and oil that are used as collectors in the flotation of phosphate, potash, and iron ore are given in Table I. If these figures are anywhere near correct, then phosphate processing consumes most of the fatty acids used for flotation. About 45% of the amines used in flotation are used in phosphate production also. The only other large consumer of flotation reagents is the potash industry, which currently consumes about 27% of all flotation amines. Despite the size of the iron industry only a small portion of the iron produced is treated by flotation and a correspondingly small portion of the total collectors is used.

The greatest increase in the consumption of flotation collectors of the fatty chemical group is likely to come from the expanding potash industry in Canada. A tremendous increase in capacity has been announced for the next five years, and if it is all brought on stream, it will nearly double the present capacity. The iron industry approximates a sleeping giant with respect to flotation, but it is unlikely that significantly large increases in flotation will occur within the next five years.

REFERENCES

- Gaudin, A. M., H. L. Miaw and H. B. Spedden, Proc. 2nd Intl. Congr. on Surface Activity, Vol. III, Butterworths, London, 1957, p. 202.
- deBruyn, P. L., Chem. Eng. Soc. Series, No. 15, Vol. 50, AIME 219, 519 (1954).
- Smolders, C. A., Rec. Trav. Chim., 60, (1941).
- Aplan, F. F., and P. L. deBruyn, Trans. SME 229, 285 (1963).
- Taggart, A. F., T. C. Taylor and C. R. Ince, Trans. AIME 87, 285 (1926).
- Gaudin, A. M., and R. Schubmann Jr., J. Phys. Chem. 40, 257 (1936).
- Peck, A. S., USBM RI 6202.
- Poling, G. W., and J. Leja, J. Phys. Chem. 67, 2121 (1963); Can. Met. Quart. 7, 109 (1962).
- Smith, R. W., and T. J. Smitik, Trans. SME 222, 194 (1965).
- Peck, A. S., and M. E. Wadsworth, AIME Preprint Annual Meeting, 1966.
- Schubmann, R. and B. Prakash, Trans. AIME 187, 501 (1959).
- Gaudin, A. M., and G. S. Chang, Trans. AIME 183, 193 (1952).
- Cooke, S. R. B., and M. Digne, Trans. AIME 184, 299 (1949).
- Kraeber, L., and A. Doppel, "Principles of Flotation," K. L. Sutherland and I. W. Wark, Aust. IMM, 1955.
- Fuerstenau, M. C., and R. B. Bhappu, Trans. SME 224, 164 (1963).
- Fuerstenau, M. C., C. C. Martin and R. B. Bhappu, Trans. SME 226, 449 (1963).

- Aplan, F. F., and D. W. Fuerstenau, "Froth Flotation," AIME, New York, 1962, ch. 7.
- Cooke, S. R. B., and W. Nummela, USBM RI 6498, 1959.
- Mallikyan, R., and V. Ramachandran, Current Science (India) No. 8, p. 299 (1956).
- Hukki, E. T., and O. Vartiainen, Trans. AIME 196, 818 (1953).
- Gaudin, A. M., and R. E. Cole, Mining Eng. 418 (1953).
- Burcell, G., and S. C. Sun, Trans. SME 226, 13 (1963).
- Duckworth, M. H., and J. M. W. MacKenzie, Trans. AIME 229, 450 (1962).
- Iwasaki, I., S. R. B. Cooke and H. S. Choi, Trans. AIME 217, 237 (1960).
- Oko, M. V., and T. Salman, Can. Min. Jnl., March 1962.
- Kivalo, P., and E. Lehmasvaara, Trans. IMDC, Stockholm, 1967.
- Sun, S. C., E. E. Snow and V. L. Purcell, Trans. AIME 208, 70 (1957).
- IMC unpublished data.
- Seeba, F., "Froth Flotation," Elsevier Publishing Company, Amsterdam, 1962.
- Schulman, J. H., and T. D. Smith, "Recent Developments in Mineral Dressing," IMM, 1953.
- Glenboecky, A., Trans. IMDC, Stockholm, 1957.
- Kihlstedt, L. G., Trans. IMDC, Stockholm, 1957.
- USBM RI 6098, 1958; by J. E. Lawrence, Mining Eng., June 1962, p. 46.
- Dasher, J. E., and R. Norman, U.S. Patent 2,471,424.
- Mitchell, D. R., H. K. Gross and H. E. Oehler, AIME Tech. Pub. 909, 1938.
- Mitchell, W. C. I., Sollenberger and T. C. Kirkland, Trans. AIME 190, 81 (1951).
- MacDonald, R. D., and R. V. Brison, "Froth Flotation," AIME 1962, ch. 12.
- Bjorn, C., and J. Keeley, Mining Eng., June 1964, p. 65-69.
- Cooke, S. R. B., I. Iwasaki and H. S. Choi, Trans. AIME 217, 86 (1960).
- Kruyt, H. R., ed., "Colloid Science," Elsevier Publishing Company, Amsterdam, 1952.
- deBruyn, P. L., and G. E. Agar, "Froth Flotation," AIME, New York, 1962.
- Fuerstenau, D. W., and H. J. Modi, Trans. AIME 217, 381 (1960).
- Joy, A. S., D. Watson and R. W. G. Cropton, Trans. AIME 222, 5 (1964).
- Somasundaram, P., and D. W. Fuerstenau, J. Phys. Chem. 70, 90 (1966).
- Fuerstenau, D. W., Trans. AIME 208, 1365 (1957).
- Iwasaki, I., S. R. B. Cooke and A. P. Colombo, USBM RI 6593, 1960.
- Iwasaki, I., S. R. B. Cooke and Y. S. Kim, Trans. AIME 223, 718 (1962).
- Choi, H. S., and K. V. Whang, J. Korean Chem. Soc. 1, 91 (1965).
- Choi, H. S., and K. V. Whang, Trans. CIM 69, 242 (1963).
- Blay, P., R. Houot and J. Cases, Proc. 7th IMPC, Gordon and Breach Publishers, New York, 1964.
- Fuerstenau, D. W., Trans. AIME, 202, 66 (1955).
- Parks, G. A., Chem. Rev. 65, 177 (1965).
- Iwasaki, I., and P. L. deBruyn, J. Phys. Chem. 62, 594 (1958); Surface Science 3, 239 (1965).
- Grabams, D. C., Chem. Rev. 41, 441 (1947).
- Fuerstenau, D. W., Ph.D. thesis, M.I.T.
- deBruyn, P. L., class notes, M.I.T.
- Iwasaki, I., Ph.D. thesis, M.I.T., 1958.
- Agar, G. R., Sc.D. thesis, M.I.T., 1961.
- Gaudin, A. M., and D. W. Fuerstenau, Trans. AIME 202, 958 (1955).
- Fuerstenau, D. W., T. W. Healy and P. Somasundaram, Trans. SME 229, 321 (1964).
- Smith, R. W., Trans. SME 226, 427 (1962).
- Fuerstenau, D. W., and B. J. Yamada, Trans. SME 223, 50 (1962).
- Somasundaram, Ph.D. thesis, U. Cal., 1964.
- Fuerstenau, M. C., and J. D. Miller, Trans. SME 235, 1965.
- Fuerstenau, D. W., A. M. Gaudin and H. L. Miaw, Trans. AIME 217, 792 (1958).
- Gaudin, A. M., D. W. Fuerstenau and H. L. Miaw, Trans. CIM LXIII, 668 (1960).
- Joy, A. S., and D. Watson, Proc. 6th IMPC, Pergamon Press Ltd., London, 1963, p. 635.
- Iwasaki, I., S. R. B. Cooke, D. H. Harraway and H. S. Choi, Trans. SME 222, 97 (1962).
- Baarsen, R. E., C. L. Ray and H. B. Treweek, "Froth Flotation," AIME, New York, 1962, ch. 17.
- McClintock, W. O., "Milling Methods in America," Gordon and Breach Publishers, New York, 1964, ch. 14.
- Iwasaki, I., 27th Annual Mining Symposium, Univ. of Minn., 1966, p. 183.
- Mitchell, J. B., K. Mackie, F. Lancaster and D. Smith, "Milling Methods in America," Gordon and Breach Publishers, New York, 1964, ch. 13.
- Bachmann, R., Z. Erz. Metall. 88, 104 (1955).
- Fuerstenau, D. W., and M. C. Fuerstenau, Trans. AIME 208, 1958.
- Rogers, J., and J. H. Schubman, 2nd Intl. Conf. on Surface Activity Preprints, PG 339, London, 1957.
- Rogers, J., IMM 607, 439 (1957).
- Schubert, F., Aufber. Tech. 4 (6) 805 (1966).

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• Obituaries

L. J. LEONARD (1956), Durkee Famous Foods, died August 8, 1967. He had been employed by Durkee Famous Foods, Chicago.