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THE VISCOSITY OF LIQUID METALS AND AN EMPIRICAL RELATIONSHIP BETWEEN THEIR ACTIVATION ENERGY OF VISCOSITY AND THEIR MELTING POINTS[1]

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Abstract It is shown that a simple empirical relationship exists between the activation energy of viscosity for liquid metals and their melting points. This relationship coupled with Da Andrade's expression for the viscosity of the liquid metal at the melting point ($T_{m.p.}$):

$$\eta_{m.p.}(\text{in poises}) = 5{\cdot}7 \times 10^{-4} \, . \, \frac{\sqrt{(A \, . \, T_{m.p.})}}{V_A^{2/3}}$$

(A = At. wt.; V_A = liq. at. volume at m.p; °K)

permits us now to estimate the viscosity of *any metal having a closepacked crystal structure*, i.e., one for which the Andrade relationship holds, at any temperature.

All available experimental data on the viscosity of metals were used to establish the *empirical relationship shown in Fig.* 2.

THE metals, from Li, the lightest, to Lw (element 103), the heaviest, represent over 80 per cent of all known elements. It has been shown recently[2] that their liquid temperature range, i.e., the ranges from their respective melting points to their critical points, are greater by far than those of any other class of substances. As monatomic elementary [illegible] they are [illegible] amenable to theoretical treatment than more complex [illegible] the liquid viscosity of the latter shows a very great temperature dependence. In the case of the metals the change is much less dramatic.

All available data on the viscosity of metals are plotted in Fig. 1, the round points showing the experimental range. The experimental data for most metals were obtained from the *Liquid Metals Handbook*, Edition 1 and 2.[3] Additional data were taken for gallium[4] and tin.[5]

ANDRADE's simple formula[6] expresses the relationship between the viscosity, η, and T, in °K., as follows:

$$\eta = a \, . \, \exp{(H_\eta/RT)} \text{ or}$$

$$\log_{10} \eta = \frac{H_\eta}{2{\cdot}303 \, . \, R} \cdot \frac{1}{T} + \log_{10} a,$$

(1) For additional details see report of A. V. GROSSE, "*The Liquid Range of Metals and Some of Their Physical Properties at High Temperatures*," The Research Institute of Temple University, September 5, 1960.
(2) A. V. GROSSE, *J. Inorg. Nucl. Chem.* 22, 23 (1961).
(3) R. N. LYON, (Editor in Chief), *Liquid-Metals Handbook*, Sponsored by The Committee on the Basic Properties of Liquid Metals, Office of Naval Research, Department of the Navy, in Collaboration with The Atomic Energy Commission and The Bureau of Ships, Department of the Navy, Washington, D.C., June 1, 1950, NAVEXOS, P-73[illegible]
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(4) K. E. SPELLS, *Proc. Phys. Soc.*, 48, 299–311 (1936); W. H. HOATHER, *ibid.* 699–707 (1936).
(5) A. J. LEWIS, *Proc. Phys. Soc.*, 47, 102–110 (1935).
(6) E. W. DA C. ANDRADE, *Phil. Mag.* 17, 698–732 (1934).