The Variation of the Dielectric Constant of Phenol with Respect to Temperature

By K. M. Somasundaram and C. V. Suryanarayana

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For the temperature variation of dielectric constant Abegg and other workers[1-4] gave the relation

$$D=D_0e^{-T/190}$$

Later work has shown, however, that the coefficient of T in the exponent is, like D_0, specific for each liquid[5,6]. The equation

$$D=D_0e^{-LT}$$

seems to hold with considerable accuracy for all the liquids hitherto examined. The second empirical constant L is seen to have the dimension of the reciprocal of temperature.

The above relation is verified with phenol.

Experimental procedure. — "BDH. Analar" variety of phenol was distilled and the fraction boiling at 181.75°C was collected and used. Dielectric constant of phenol was determined at different temperatures ranging from 41.5 to 65.9°C. "Dekameter type DK03" of Wissenschaftlich Technische Werkstätten was used at a fixed frequency of 1.8 MC/sec., controlling the temperature of the cell with Hoppler's ultrathermostat. The results are given in the following table.

t°C	41.5	42.3	49.8	50.6	58.1
D	11.78	11.72	11.10	11.03	10.48
t°C	60.7	64.8	65.4	65.5	65.9
D	10.32	10.03	9.98	9.97	9.95

From the above data a plot of $\log_{10}D$ versus T is a straight line and the variation of dielectric constant with temperature may be represented best by the relation

$$D=D_0^{-LT}$$

where $D_0=109.8$ and $L=0.007094$.

It may be of interest that the data of Smyth and Hitchcock[7] for crystalline phenol has been tried by us to fit into the exponential equation. A plot of $\log_{10}D$ versus T gives a curve tending towards a limiting value. The exponential equation, as pointed by Abegg, is valid only for liquids.

Physico-Chemical Laboratory
Annamalai University
Annamalainagar, South India

1) Abegg, *Ann. Physik.*, **60**, 54 (1897).
2) Abegg and Seitz, *Z. physik. Chem.*, **29**, 242 (1899).
3) Walden, ibid., **70**, 569 (1909).
4) Tangl, *Ann. Physik.*, **26**, 59 (1908).
5) Lowry and Jessop, *Trans. Chem. Soc.*, 782 (1930).
6) Akerlöf, *J. Am. Chem. Soc.*, **54**, 4125 (1932).
7) Smyth and Hitchcock, ibid., **54**, 4631 (1932).