LETTERS TO THE EDITOR

ULTRASONIC STUDIES IN AQUEOUS SOLUTIONS OF URANYL NITRATE

It is known that electrolytes in general exhibit increase of ultrasonic velocity with concentration. However, deviations from this type of behaviour have been reported by some.[1–5] In the course of our studies we found that uranyl nitrate showed a decrease of ultrasonic velocity with increasing concentration. All other properties like adiabatic compressibility, molar sound velocity varied regularly.

In the present investigation the double-crystal, fixed-path, variable frequency interferometer[6] was used for the measurement of ultrasonic velocity. The sample used is of B.D.H., Analar quality. All measurements were carried out at a temperature of 32° C. The accuracy of the interferometer is 1 metre/sec. Adiabatic compressibility and apparent molal compressibility were calculated by the usual formulæ. The molar sound velocity R, and molar compressibility, B, were calculated using the relations,

$$R = \frac{M}{\rho} V^{1/3} \quad \text{and} \quad B = \frac{M}{\rho} \beta^{-1/7}$$

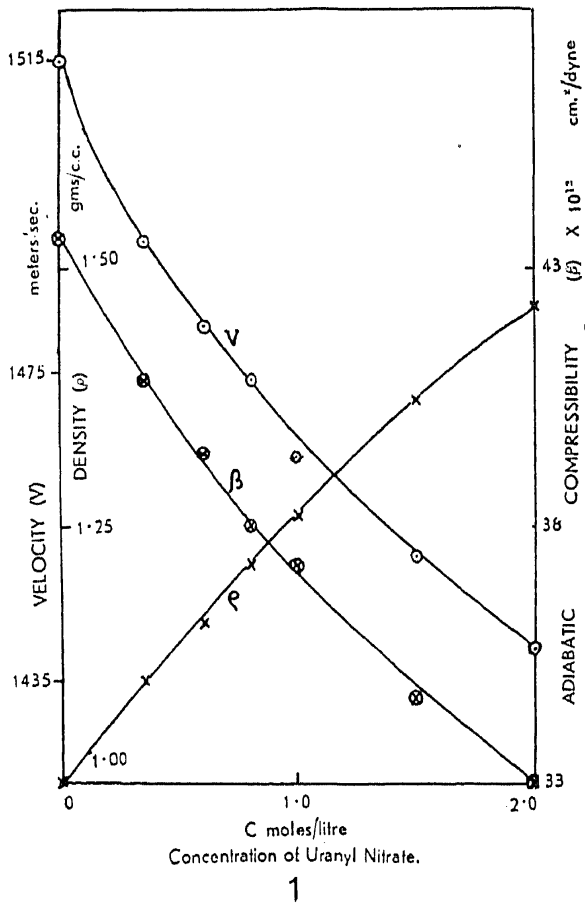
M is the average molecular weight of the solution given by $(n_1 M_1 + n_2 M_2)/(n_1 + n_2)$ where, n_1 and M_1 and n_2 and M_2 are respectively the number of moles and molecular weights of the solute and the solvent. The molar concentration was calculated using the relation $C_m = n_1/n_1 + n_2$. The results are presented in Table I.

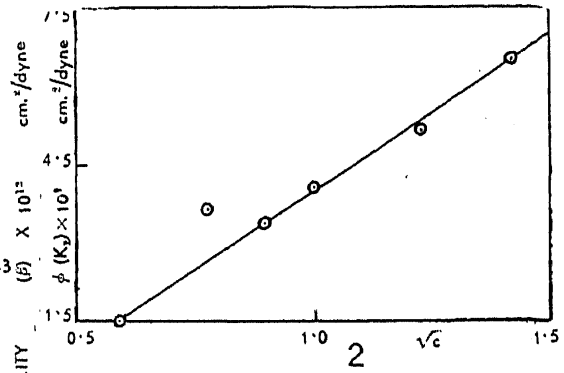
TABLE I

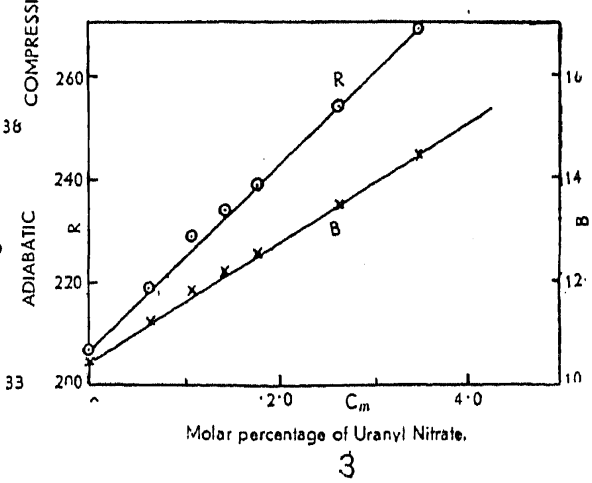
Uranyl nitrate

$[UO_2(NO_3)_2 . 6H_2O]$. *Mol. wt.* 502·18, $T. = 32°$ C.

C Conc. Moles/litre	V Velocity Metres/sec.	ρ Density gm./ml.	$\beta_{ad} \times 10^{12}$ cm.^{2}/dyne	$\phi (K_2) \times 10^{12}$	R	B	C_m % Molar Conc.
0	1515	1·000	43·57	..	206·9	10·51	0
0·35	1492	1·100	40·83	1500	218·7	11·27	0·627
0·60	1481	1·157	39·41	3553	228·5	11·86	1·070
0·80	1474	1·212	37·97	3333	233·8	12·22	1·421
1·00	1459	1·263	37·18	4030	238·8	12·56	1·770
1·50	1451	1·371	34·64	5153	253·9	13·52	2·632
2·00	1439	1·462	33·04	6552	268·9	14·45	3·478







FIGS. 1-3

Figure 1 shows the variations of ultrasonic velocity, adiabatic compressibility, and density with the concentration of the electrolyte expressed as moles/l. Figure 2 shows the plot of the apparent molal compressibility $\phi(K_2)$, against the square-root of concentration ($\sqrt{c}$), which is linear. Figure 3 shows the variations of R and B with molar concentration (C_m) of the electrolyte, which are also linear. Figure 1 shows that the ultrasonic velocity decreases with increase of concentration (76 metres/sec. for a concentration of 2 moles/l.), whereas, the density is steadily increasing and the compressibility is steadily decreasing. The slope of the curve, apparent molal compressibility *vs.* square-root of concentration, *i.e.*, $\delta\phi(K_2)/\delta\sqrt{c}$, should be $32{\cdot}6 \times 10^{10}$ c.g.s. units as calculated from Gucker's limiting equation, as uranyl nitrate is a (2-1) type of electrolyte. The experimental slope is, however, 55×10^{10} c.g.s. units which is far from the theoretical value. The decrease of velocity in uranyl nitrate is in conformity with the observations of previous workers,[3] namely that electrolytes with heavy acid or metallic radicals produce decrease in velocity with increasing concentration.

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Waltair, *November* 18, 1961.

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