NOTES

Ultrasonic Study of Molecular Compounds of Oxalic Acid with Urea, Thio-urea and Allyl-thiourea

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Urea is known to form an inclusion compound with a few dicarboxylic acids, such as oxalic acid. The work has been extended to ascertain the formation of such compounds with thiourea and allyl thiourea by measuring the ultrasound velocity in the aqueous medium and the present note deals with such study.

A suitable optical glass-cell[1] was designed for keeping the solution and with the help of the filter, the light of wavelength 3656.71 Å from a mercury vapour lamp was allowed to fall at right angles to the path of ultrasound waves. As shown by Debye and Sears[2] ultrasound waves traversing a liquid set up a periodical inhomogeneity which acts as an optical grating. The diffraction pattern was photographed on orthochromatic AGFA plates and the distance between fringes was measured by a comparator.

The source of ultrasonic power was a generator having a gold plated circular quartz crystal 1″ in diameter as transducer. The 0.1M solution of oxalic acid, urea, thiourea and allyl thiourea were prepared in double distilled water. All reagents were A. R. grade. Mixtures of various composition were prepared by adding to fixed volume of oxalic acid, different volumes of urea, thiourea and allyl thiourea solution and then the total volume was raised to 50 ml. In each case photographs for the diffraction pattern of the solutions were taken at 25° ± 0.1°C. The density of each mixture was measured just after the velocity measurement with the help of density bottle. Adiabatic compressibility of each mixture was calculated using the equation $\beta = 1/V^2\rho$ where V is the ultrasonic velocity and ρ the density of the solution. Compressibility lowering values of mixtures were obtained by subtracting the compressibility of mixtures from the

compressibility of water which is 44.04 cm²/dyne × 10^{12}. The probable errors involved in the measurement of the ultrasonic velocity and compressibility are 0.15 and 0.4 per cent respectively.
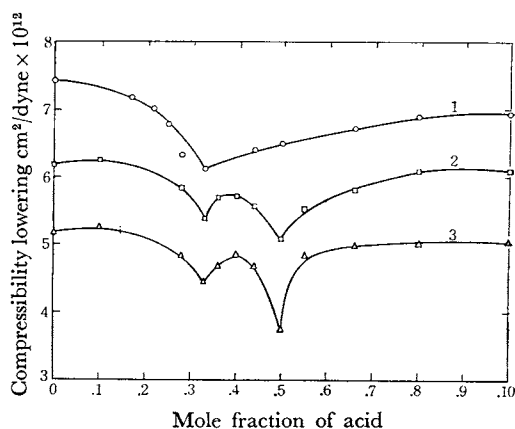

Fig. 1. Variation of compressibility lowering with composition at fixed temperature mixtures are equi-molar (0.1M).
1. Urea + Oxalic acid, 2. Allyl thiourea + Oxalic acid 3. Thio-urea + Oxalic acid

From the figure, it is observed that in each case the sound velocity and compressibility lowering decreases at first with increase in mole fraction of oxalic acid, it passes through a minimum and then increases. In case of urea a break is obtained at 1-oxalic acid - 2- urea composition in conformity with the result of Radell and Brodman,[3] while in the other two there are two breaks, one corresponding to 1 : 1 and the other to 1 : 2. The minima in the curves indicate the stoichiometry in which the reactant interact and thus they exhibit the composition of the compounds formed.

1) S. P. Srivastava, Sheo Prakash and S. Prakash, *Z. Physik. Chem.*, **50**, 3/4, (1966).

2) P. Debye and F. W. Sears, *Proc. Nat. Acad Sci. U. S. A.*, **18**, 410 (1932).

3) J. Radell, B. W. Brodman and J. J. Domanski, *J. Phys. Chem.*, **71**, 1556 (1967).