STUDY OF ULTRASONIC VELOCITY IN ORGANIC SOLUTIONS

WHILE investigating ultrasonic velocities in solutions of organic substances like naphthalene, etc., in organic solvents, Schaaffs[1] and others[2] have shown that, in general, the ultrasonic velocity increases linearly with concentration. Subsequently Lal and Sharma[3] have reported a consistent decrease of ultrasonic velocity with increase of concentration for the solution of benzoic acid in several alcohols. It was also shown that the molar sound velocity R of the solution increases linearly with molar fraction and that the extrapolated value for 100% concentration is a characteristic constant for the pure solid. In a recent communication Lal[4] has utilised Rao's equation to calculate the ultrasonic velocity in the pure solid solute existing in a hypothetical liquid state and the value thus obtained for benzoic acid was reported as 3,920 m./sec.

The authors have systematically investigated the ultrasonic velocities in solutions of benzoic acid in chloroform, benzene and ethyl alcohol using the variable frequency fixed path interferometer[5] and the results are presented in Table I.

It will be seen from the results presented in Table I that the velocity increases with concentration for all the solvents studied in a more or less linear manner, a result which is contrary to the conclusions of Lal and Sharma.[3] But as reported by them, the values of R are found to increase linearly with molar fraction, but the average of the extrapolated values for 100% concentration obtained by us is 1174 as against the average value of 1527 reported by them. It is to be noted that the present value of R compares favourably with the calculated value of 1213 obtained by Rao's method of atomic increments and the value of 1199 obtained by Lagemann method of bond increments.

TABLE I

Room Temperature 30° C.

Benzoic acid chloroform ..	Cm. %	0	2·595	5·051	7·401	9·618	100 (extrapolated)
	V m./s.	985	991	998	1012	1027	1620
	R	807·6	816·0	823·5	831·6	841·0	1151
Benzoic acid Benzene ..	Cm. %	0	2·388	4·660	6·829	..	100 (extrapolated)
	V m./s.	1294	1297	1304	1312	..	1632
	R	975·2	978·8	984·5	991·7	..	1216
Benzoic acid–ethyl alcohol	Cm. %	0	1·540	3·031	4·479	..	100 (extrapolated)
	V m./s.	1140	1151	1160	1168	..	1718
	R	587·3	606·1	614·6	622·6	..	1154

As the variation of ultrasonic velocity with concentration is almost linear, in the limited concentration range possible, the velocity for 100% concentration is obtained by extrapolation and the values thus obtained for the three solvents are fairly consistent. This velocity does not correspond to the velocity of the solute in the solid state but it corresponds to the characteristic velocity for the hypothetical case of the solute existing in the liquid state at the room temperature. This value cannot therefore be checked by a direct determination. However, it is interesting to note that this average value 1657 m./sec. is in reasonable agreement (considering the wide range of extrapolation) with the value of 1506 m./sec. obtained from Rao's formula using the known value of R for the solute and assuming a density[6] value of 1·166 gm./c.c.

Ultrasonic Laboratories, B. RAMACHANDRA RAO.
Andhra University, K. SUBBA RAO.
Waltair,
December 29, 1958.

1. Schaaffs, W., *Zeit. F. Phys.*, 1937, **105,** 658.
2. Sibaiya, L. and Narasimhaiya, R. L., *J. Mys. Univ.*, 1941, **1 B,** 133.
3. Lal, K. C. and Sharma, P. N., *Zeit. F. Phys. Chem.*, 1957, **206,** 231.
4. —, *Curr. Sci.*, 1958, **27,** 387.
5. Rao, B. R. and Rao, K. S., *J. Sci. and Ind. Res.*, 1957, **16 B,** 483.
6. Timmermans, J., *Physico-Chemical Constants of Pure Organic Compounds*, Elsevier Publishing Co., Inc., New York, 1950, p. 480.