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NOTE

Ultrasonic Velocity, Viscosity and Density of Chloro Substituted 2-Hydroxy Acetophenones in Ethanolic Solution at 303.15 K

SANJAY UBALE†, N.G. PALASKAR‡, MAZAHAR FAROOQUI*,
PATHAN MOHD ARIF ALI and A.S. SHANKARWAR**
Aurangabad College for Women, Aurangabad, India

Density, ultrasonic velocities and relative viscosities of 3-chloro-2-hydroxy-acetophenone and 3,5-dichloro-2-hydroxyacetophenone in ethanolic solutions have been measured as a function of electrolyte concentration at 303.15 K. The experimental data is used to calculate molar volume, apparent molar compressibility, etc. These parameters are used to interpret the solvent-solvent, ion-solvent and solute-solvent interactions.

For liquid mixtures, acoustical properties are of great significance in studying their physico-chemical behaviour and molecuar interactions[1–5]. A large number of physico-chemical investigations of simple inorganic salts have been made in aqueous and nonaqueous media.[6, 7] The interaction studies of the chloro substituted acetophenones are still lacking. Therefore, in the present study, we report viscosity, density and ultrasonic velocity of these compounds.

3-Chloro-2-hydroxy acetophenone, 5-chloro-2-hydroxy acetophenone and 3,5-dichloro-2-hydroxy acetophenone were prepared and purified by the standard methods.[8] Spectrograde ethanol was used as a solvent. The densities of ethanol and chloro-substituted acetophenone were determined in 15 mL bicapillary pycnometers. Velocity of sound was measured using single crystal interferometer (Mittal Enterprises M-81) using a cell frequency of 4 MHz. The viscosity measurements were performed by using Schoff Gerate (AVS 350) viscosity measuring system equipped with a series of Ubbelhode viscometers.

†Deogiri College, Aurangabad, India.
‡Dept. of Chemisty, Dr. B.A.M.U. Aurangabad, India.
**Science College, Kannad, India.

TABLE-1
DENSITY (ρ), ULTRASONIC VELOCITY (V) AND FLOW TIME OF CHLORO-SUBSTITUTED ACETOPHENONES

Conc. (mol dm^{-3})	ρ ($g\ cm^{-3}$)	V ($m\ s^{-1}$)	ε (s)
3-Chloro-2-hydroxy acetophenone			
0.00	0.78075	1148.00	130.50
0.02	0.78252	1150.50	132.62
0.04	0.78427	1153.20	134.04
0.06	0.78599	1157.67	136.86
0.08	0.78769	1158.32	138.97
0.10	0.78937	1160.84	140.09
5-Chloro-2-hydroxy acetophenone			
0.00	0.78075	1148.00	130.50
0.02	0.78263	1150.45	132.64
0.04	0.78499	1152.96	134.71
0.06	0.78632	1155.50	136.81
0.08	0.78813	1158.00	138.87
0.10	0.78992	1160.52	141.01
3-5-dichloro-2-hydroxy acetophenone			
0.00	0.78075	1148.00	130.50
0.02	0.78234	1150.41	132.47
0.04	0.78471	1152.61	134.43
0.06	0.78666	1155.00	136.40
0.08	0.78858	1157.38	138.34
0.10	0.79048	1159.77	140.30

The values of density, ultrasonic velocity and viscosity show increasing trend with concentration (Table-1). The study of Φ_v, Φ_k and β-coefficient can furnish useful information on the nature of solute-solvent and ion-solvent interactions (Table-2). It is clear from the data that variation in Φ_v, Φ_k and β-coefficient (Table-3) is in the order of:

Φ_v^0: 3,5-$(Cl)_2$-OHA > 3-Cl-OHA > 5-Cl-OHA

$-\Phi_k^0$: 5-Cl-OHA > 3-Cl-OHA > 3,5-$(Cl)_2$-OHA

β: 3-Cl-OHA > 5-Cl-OHA > 3,5-$(Cl)_2$-OHA

Thus no uniform trend is observed in these three parameters. From Φ_v^0 values, we can conclude that solute-solvent interaction is maximum for 3,5-$(Cl)_2$OHA; this is because of the powerful σ and π withdrawing influence of substituent chlorine. β-values depend upon ionic size, charge and solute-solvent interactions. The larger values for S_v suggest strong solute-solute interaction in ethanol. S_k values however are low and are in line with the generally reported S_k for various organic compounds.

TABLE-2
APPARENT MOLAR VOLUME (Φ_v), APPARAENT MOLAR COMPRESIBILITY (Φ_k) AND RELATIVE VISCOSITY AT 303.15 K

Conc. (mol dm^{-3})	$\Phi \times 10^6$ (m^3 mol^{-1})	$\Phi \times 10^{16}$ (m^3 mol^{-1} Pa^{-1})	η_r (s)
3-chloro-2-hydroxy acetophenone			
0.00	70.89	3.500	–
0.02	73.66	3.464	1.01850
0.04	74.32	3.453	1.03175
0.06	75.24	3.379	1.05577
0.08	76.03	3.383	1.07437
0.10	76.76	3.398	1.08530
5-Chloro-2-hydroxy acetophenone			
0.00	64.13	3.533	–
0.02	64.65	3.512	1.01880
0.04	65.82	3.497	1.03720
0.06	66.25	3.488	1.05580
0.08	67.05	3.464	1.07410
0.10	67.79	3.440	1.09340
3,5-dichloro-2-hydroxy acetophenone			
0.00	99.64	3.148	–
0.02	100.36	3.121	1.01760
0.04	100.42	3.115	1.03555
0.06	101.49	3.082	1.05310
0.08	102.25	3.065	1.07070
0.10	102.94	3.040	1.08840

TABLE-3
Φ_v^0, Φ_k^0 VISCOSITY, β-COEFFICIENT, S_v AND S_k VALUES OF CHLORO-SUBSTITUTED ACETOPHENONES IN ETHANOL AT 303.15 K

Compound	$\Phi_v^0 \times 10^6$ ($m^3 mol^{-1}$)	$S_v \times 10^6$ (m^3 mol^{-2} lit)	$\Phi_k^0 \times 10^{16}$ (m^3 mol^{-2} Pa^{-1})	$S_k \times 10^{16}$ (m^3 mol^{-2} Pa^{-1})	β dm^3 mol^1
3-Cl-OHA	70.89	65.97	3.500	–1.610	0.935
5-Cl-OHA	64.13	35.68	3.533	–0.885	0.931
3,5-$(Cl)_2$-OHA	99.64	32.84	3.148	–1.060	0.883

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ERRATA

Thermodynamic Behaviour of Hypersensitive Transitions Observed in Some Pr(III) Doped Systems
[Vol. 13, No. 3 (2001), pp. 1133–1136]

On p. 1134, under the subheading "Calculation of thermodynamic parameters", in line 5:

for	$A = E = 2.303KT \log P$
read	$A = E + 2.303KT \log P$

On the same page under the same subheading, in line 17:

for	$g_i = 2J + 1$ (*e.g.*, $g_i = 5$ for $^2P_2$)
read	$g_i = 2J + 1$ (*e.g.*, $g_i = 5$ for $^3P_2$)