ACTA UNIVERSITATIS LODZIENSIS
FOLIA CHIMICA 5, 1985

Stefania Taniewska-Osińska, Bartłomiej Pałecz

VISCOSITY MEASUREMENTS OF NaI AND KNO_3 SOLUTIONS IN WATER - HYDROXYUREA MIXTURES AT VARIOUS TEMPERATURES

Density and viscosity measurements were made of NaI and KNO_3 solutions (concentration 1.0 mole electrolyte per 100^2 mole mixed solvent) in the temperature range of 292.15 - 313.15 K.

Introduction

The pysico-chemical properties of aqueous solutions of urea derivatives have been investigated in our laboratory for several years now [1]. The results reported here come from densimetric and viscosimetric investigations of aqueous solutions of hydroxyurea derivative (HU) with two electrolytes, NaI and KNO_3, in the temperature range of 293.15 - 313.15 K.

Experimental procedure

Analytically pure NaI (POCh Gliwice, Poland) was crystallized from a water - acetone mixture and dried at 333 K.

Analytically pure KNO_3 (POCh Gliwice, Poland) was crystallized from water and dried at 373 K.

Hydroxyurea (ZF Polfa, Poland) was crystallized twice from methanol and dried at 373 K. The solutions were prepared by weight.

The viscosity measurements were conducted using Ubbelohde viscosimeters. The systems used and the viscosity and density measurement techniques have been described in earlier reports [2,3].

Results and discussion

The density values obtained for aqueous solutions of hydroxyurea with NaI and KNO_3 are collected in Tables 1 and 2. As can be seen from these tables, an increase in hydroxyurea concentration is accompanied by an increase in the density of the solutions, while a temperature rise is accompanied by a density decrease.

Using the density values for the solutions under study we calculated the volume expansibility coefficients (Table 3). As the content of the urea derivative increases, the volume expansibility coefficients for the solutions of both electrolytes increase and their values are higher than those for the binary water-hydroxyurea system [2].

The dynamic viscosity values for the aqueous hydroxyurea solutions with NaI and KNO_3 are collected in Tables 1 and 2. Using the dynamic viscosity values for two-component water-hydroxyurea systems [2] we calculated the relative viscosity values for the systems under investigation, taking a three-component system as a pseudo-binary (Table 4). With increasing concentration and temperature the relative viscosities of aqueous hydroxyurea solutions of both electrolytes increase (Table 4). Using the relative viscosity values we calculated the temperature coefficients of relative viscosity $\frac{\Delta \eta_r}{\Delta T}$ (Table 5). The positive values of $\frac{\Delta \eta_r}{\Delta T}$ indicate that NaI and KNO_3 have a structure-breaking effect on the mixed solvent [4,5].

Table 1. Density and viscosity of NaI solutions in water-hydroxyurea mixtures in the temperature range of 293.15 - 313.15 K.

m (HU)	293.15 K		298.15 K		303.15 K		313.15 K	
mol kg^{-1}	ρ g cm^{-3}	η cP	ρ g cm^{-3}	η cP	ρ g cm^{-3}	η cP	ρ g cm^{-3}	η cP
0.0000	1.0607	1.0101	1.0591	0.9018	1.0576	0.8024	1.0532	0.6735
0.1586	1.0647	1.0297	1.0628	0.9181	1.0614	0.8153	1.0572	0.6845
0.3102	1.0686	1.0497	1.0666	0.9343	1.0650	0.8294	1.0610	0.6948
0.5147	1.0735	1.0731	1.0715	0.9560	1.0698	0.8468	1.0656	0.7085
0.6905	1.0780	1.0943	1.0759	0.9743	1.0740	0.8615	1.0698	0.7189
0.6950	1.0782	1.0950	1.0762	0.9752	1.0743	0.8632	1.0700	0.7195
0.7227	1.0785	1.0987	1.0766	0.9779	1.0746	0.8652	1.0706	0.7232
0.9091	1.0835	1.1196	1.0814	0.9977	1.0794	0.8812	1.0752	0.7366
1.2040	1.0901	1.1546	1.0878	1.0266	1.0858	0.9070	1.0817	0.7562

Table 2. Density and viscosity of KNO_3 solutions in water-hydroxyurea mixtures in the temperature range of 293.15 - 313.15 K.

m (HU)	293.15 K		298.15 K		303.15 K		313.15 K	
mol kg^{-1}	ρ g cm^{-3}	η cP	ρ g cm^{-3}	η cP	ρ g cm^{-3}	η cP	ρ g cm^{-3}	η cP
0.0000	1.0317	0.9828	1.0311	0.8782	1.0287	0.7815	1.0245	0.6553
0.1586	1.0352	0.9988	1.0340	0.9013	1.0325	0.7933	1.0280	0.6658
0.3102	1.0390	1.0155	1.0372	0.9157	1.0360	0.8072	1.0315	0.6753
0.5147	1.0440	1.0376	1.0428	0.9349	1.0410	0.8230	1.0363	0.6894
0.6905	1.0487	1.0556	1.0470	0.9521	1.0453	0.8372	1.0407	0.6993
0.6950	1.0489	1.0560	1.0471	0.9529	1.0455	0.8382	1.0409	0.6997
0.7227	1.0492	1.0598	1.0476	0.9552	1.0458	0.8399	1.0411	0.7034
0.9091	1.0540	1.0803	1.0520	0.9731	1.0503	0.8547	1.0455	0.7155
1.2040	1.0616	1.1110	1.0593	1.0006	1.0573	0.8784	1.0525	0.7327

Table 3. The valume expansibility coefficient (α) of NaI and KNO_3 in water-hydroxyurea solutions.

m (HU) mol kg^{-1}	$\alpha \times 10^5$ / K^{-1}	
	HU-H_2O-NaI	HU-H_2O-KNO_3
0.0000	35.4	34.9
0.1586	35.4	34.9
0.3102	35.7	36.1
0.5147	36.9	36.9
0.6905	38.1	38.3
0.6950	38.2	38.3
0.7227	38.7	38.7
0.9091	38.6	40.5
1.2040	38.8	43.0

Table 4. Relative viscosity of NaI and KNO_3 solutions in water-hydroxyurea mixtures in the temperature range 293.15 ÷ 313.15 K.

m (HU) mol kg^{-1}	η_r							
	NaI				KNO_3			
	293.15 K	298.15 K	303,15 K	313.15 K	293.15 K	298.15 K	303.15 K	313.15 K
0.0000	1.0080	1.0129	1.0189	1.0313	0.9809	0.9864	0.9924	1.0033
0.1586	1.0114	1.0154	1.0205	1.0325	0.9811	0.9968	0.9930	1.0042
0.3102	1.0143	1.0172	1.0215	1.0336	0.9813	0.9970	0.9942	1.0046
0.5147	1.0147	1.0198	1.0233	1.0340	0.9812	0.9973	0.9946	1.0061
0.6905	1.0175	1.0208	1.0238	1.0345	0.9815	0.9975	0.9948	1.0063
0.6950	1.0179	1.0209	1.0245	1.0348	0.9817	0.9976	0.9948	1.0064
0.7227	1.0180	1.0215	1.0249	1.0353	0.9820	0.9978	0.9949	1.0070
0.9091	1.0182	1.0232	1.0258	1.0369	0.9825	0.9980	0.9950	1.0071
1.2040	1.0211	1.0240	1.0276	1.0400	0.9826	0.9982	0.9952	1.0076

Table 5. Temperature coefficients of relative viscosity of NaI and KNO_3 solutions in water-hydroxyurea mixtures in the temperature range of 293.15 -313.15 K.

m(HU) mol kg^{-1}	$\frac{\Delta \eta_r}{\Delta T} \times 10^3$ / K^{-1}	
	NaI	KNO_3
0.0000	1.16	1.12
0.1586	1.06	1.15
0.3102	0.97	1.16
0.5147	0.96	1.21
0.6905	0.85	1.21
0.6950	0.85	1.24
0.7227	0.86	1.24
0.9091	0.93	1.23
1.2049	0.94	1.22

References

1. S. Taniewska-Osińska, B. Pałecz, J. Chem. Thermodynamics, 14, 11 (1982).
2. B. Pałecz, Doctoral thesis. Łódź University (1982)
3. S. Taniewska-Osińska, P. Chądzyński, Acta Univ. Lodz., ZNUŁ II, 6, 37 (1976)
4. M. Kaminsky, Disc. Faraday Soc., 24, 171 (1957)
5. M. Kaminsky, Z. Phys. Chem., 5, 154 (1955), 8, 173 (1956), 12, 206 (1957)

Department of Physical Chemistry University of Łódź

Stefania Taniewska-Osińska, Bartłomiej Pałecz

POMIARY LEPKOŚCI ROZTWORÓW NaI I KNO_3 W MIESZANINACH WODNO-HYDROKSYMOCZNIKOWYCH W KILKU TEMPERATURACH

Zmierzono gęstości i lepkości roztworów NaI i KNO_3 o stężeniu 1.0 mol elektrolitu w 100 molach mieszanego rozpuszczalnika wodno-hydroksymocznikowego w przedziale temperatur 293.15 - 313.15 K. Wyliczono lepkości względne oraz $\frac{\Delta\eta_r}{\Delta T}$ dla obydwu układów i przedyskutowano je.