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THE VALUES OF THE VISCOSITY COEFFICIENTS OF NaI SOLUTIONS
IN THE MIXTURES OF WATER WITH BUTANOL ISOMERS

The viscosity of NaI solutions at concentrations of 0.5, 1.0 and 2.0 moles of electrolyte per 100 moles of the mixed solvent has been measured within the whole composition range of the mixtures of water with isobutanol, sec-butanol at 298.15 K and with tert-butanol at 299.15 K.

INTRODUCTION

For several years systematic investigations of the physico-chemical properties of water with monohydroxyl alcohol mixtures and of electrolytic solutions in those mixtures have been carried out in our laboratory. The presented work follows the viscosimetric investigations of the NaI-water-monohydroxyl alcohol systems [1-5]. The results of the measurements of viscosity of NaI solutions in the mixed solvents allow to draw some conclusions concerning the effect of electrolytes on solvent structure.

THE EXPERIMENTAL METHOD AND THE RESULTS

The viscosity measurements were performed using Ubbelohde viscometers. The viscosity and density were measured with the system and method described earlier [1, 2].

The measurements of the viscosity and density of the mix-

Viscosity and density of NaI solutions in water-isobutanol mixtures at 298.15 K; c - salt concentration in moles per 100 moles of solvent, $X_2\%$ - molar percentage of alcohol

$X_2\%$	$c = 0$		$c = 0.5$		$c = 1$		$c = 2$	
	$\rho_0/\text{g}\cdot\text{cm}^{-3}$	η_0/cP	$\rho/\text{g}\cdot\text{cm}^{-3}$	η/cP	$\rho/\text{g}\cdot\text{cm}^{-3}$	η/cP	$\rho/\text{g}\cdot\text{cm}^{-3}$	η/cP
0	0.9971	0.8903	1.0285	0.896	1.0589	0.902	1.1179	0.919
1.5	0.9881	1.157	1.0178	1.159	1.0468	1.161	1.1026	1.171
60.0	0.8259	3.120	0.8343	3.249	-	-	-	-
65.0	0.8206	3.074	0.830	3.222	0.8385	3.336	0.8562	3.566
70.0	0.8171	3.059	0.8255	3.208	0.8341	3.330	0.8508	3.560
75.0	0.8132	3.033	0.8215	3.190	0.8294	3.319	0.8453	3.573
80.0	0.8096	3.049	0.8172	3.214	0.8251	3.353	0.8402	3.626
85.0	0.8065	3.042	0.8141	3.221	0.8215	3.366	0.8360	3.648
90.0	0.8026	3.132	0.8099	3.322	0.8170	3.502	0.8311	3.830
92.5	0.8018	3.159	0.8089	3.366	0.8160	3.540	0.8298	3.875
95.0	0.8000	3.218	0.8070	3.436	0.8148	3.626	0.8276	3.979
97.5	0.7988	3.283	0.8057	3.510	0.8125	3.701	0.8258	4.075
99.9	0.7978	3.356	0.8047	3.588	0.8115	3.801	0.8247	4.185

Table 2

Viscosity and density of NaI solutions in water-sec-butanol mixtures at 298.15 K; c - salt concentration in moles per 100 moles of solvent, x_2 - molar percentage of alcohol

x_2	c = 0		c = 0.5		c = 1.0		c = 2.0	
	$\rho/g.cm^{-3}$	η/cP	$\rho/g.cm^{-3}$	η/cP	$\rho/g.cm^{-3}$	η/cP	$\rho/g.cm^{-3}$	η/cP
0	0.99707	0.8903	1.0285	0.8959	1.0589	0.9016	1.1179	0.9190
2.48	0.9837	1.361	1.0122	1.3543	1.0401	1.349	1.0939	1.349
34.44	0.8666	3.279	0.8798	3.381	0.8929	3.435	0.9190	3.537
39.97	0.8569	3.200	0.8691	3.292	0.8812	3.359	0.9050	3.485
45.68	0.8483	3.126	0.8597	3.229	0.8708	3.302	0.8928	3.448
52.10	0.8397	3.017	0.8502	3.133	0.8604	3.212	0.8807	3.376
62.53	0.8283	2.852	0.8377	2.975	0.8468	3.074	0.8648	3.266
65.64	0.8254	2.806	0.8343	2.938	0.8432	3.038	0.8606	3.245
67.72	0.8236	2.783	0.8301	2.908	0.8410	3.020	0.8580	3.226
70.50	0.8211	2.751	0.8296	2.880	0.8380	2.991	0.8550	3.213
75.90	0.8168	2.711	0.8250	2.855	0.8329	2.968	0.8488	3.202
78.57	0.8149	2.701	0.8230	2.850	0.8308	2.971	0.8464	3.212
82.96	0.8118	2.704	0.8195	2.865	0.8271	2.990	0.8421	3.246
87.02	0.8091	2.719	0.8167	2.885	0.8241	3.032	0.8388	3.302
90.83	0.8070	2.771	0.8143	2.949	0.8213	3.094	0.8354	3.388
95.24	0.8046	2.861	0.8115	3.044	0.8185	3.205	0.8321	3.525
97.56	0.8032	2.923	0.8103	3.105	0.8169	3.264	0.8303	3.589
100.00	0.8016	3.112	0.8084	3.295	0.8151	3.459	0.8281	3.799

Viscosity and density of NaI solutions in water-tert-butanol mixtures at 299.15 K; c - salt concentration in moles per 100 moles of solvent, x_2 - molar percentage of alcohol

x_2	c = 0		c = 0.5		c = 1		c = 2	
	$\rho_0/\text{g}\cdot\text{cm}^{-3}$	η_0/cP	$\rho/\text{g}\cdot\text{cm}^{-3}$	η/cP	$\rho/\text{g}\cdot\text{cm}^{-3}$	η/cP	$\rho/\text{g}\cdot\text{cm}^{-3}$	η/cP
0	0.9968	0.869	1.0279	0.876	1.0584	0.883	1.1172	0.899
2.5	0.9855	1.251	1.0142	1.256	1.0421	1.249	1.0962	1.252
5.0	0.9703	2.037	0.9962	1.999	1.0215	1.971	1.0701	1.927
7.5	0.9558	2.589	0.9796	2.539	1.0028	2.497	1.0478	2.452
10.0	0.9405	3.042	0.9645	3.001	0.9866	2.966	1.0283	2.912
15.0	0.9166	3.749	0.9359	3.727	0.9551	3.709	0.9923	3.670
20.0	0.8966	4.191	0.9139	4.201	0.9312	4.199	0.9654	4.218
25.0	0.8796	4.455	0.8952	4.492	0.9105	4.512	0.9410	4.574
30.0	0.8654	4.597	0.8799	4.660	0.8940	4.700	0.9220	4.810
40.0	0.8434	4.604	0.8553	4.711	0.8677	4.800	0.8911	4.970
50.0	0.8261	4.483	0.8367	4.633	0.8469	4.738	0.8675	4.980
60.0	0.8126	4.296	0.8222	4.474	0.8313	4.617	0.8496	4.975
70.0	0.8016	4.102	0.8104	4.305	0.8183	4.481	0.8347	4.831
80.0	0.7929	3.968	0.8007	4.190	0.8083	4.390	0.8235	4.833
85.0	0.7888	3.930	0.7963	4.164	0.8039	4.397	0.8184	4.898
90.0	0.7855	3.933	0.7930	4.134	0.8001	4.451	0.8144	5.034
92.5	0.7841	3.943	0.7912	4.213	0.7981	4.471	0.8121	5.092
95.0	0.7822	3.957	0.7892	4.272	0.7961	4.566	0.8100	5.241
100.0	0.7799	4.078	-	-	-	-	-	-

tures of water with isobutanol, sec-butanol and tert-butanol, as well as of the NaI solutions in these mixtures were performed at 298.15 K for isobutanol and sec-butanol and at 299.15 K for tert-butanol within the whole range of miscibility of these alcohols with water. The measurements on the electrolyte solutions were carried out at 0.5, 1.0 and 2.0 moles of NaI per 100 moles of the mixed solvent. The viscosity results are given in Tables 1-3.

The relation between the viscosity of the mixtures of water with the butanol isomers and of the NaI solutions in those mixtures vs the molal composition of the chosen alcohol is similar to the observed for NaI-water-isopropanol system [2]. The viscosity maximum occurs at ca. 35 mol % of tert-butanol and the minima at ca. 80, 82, 92 mol % of isobutanol, sec-butanol and tert-butanol, respectively. The absence of the viscosity maxima in the mixtures of water with the isobutyl and sec-butyl alcohols is associated with the limited miscibility of these alcohols with water. The position of the viscosity maxima and minima depends on the concentration of the electrolyte. With growing concentration of NaI the position of the maximum shifts towards the higher alcohol content while the minima shift in the opposite direction.

The discussion of the results of the viscosity measurements for NaI solutions in water-alcohol mixtures has been published in another work [5].

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WARTOŚCI WSPÓŁCZYNNIKÓW LEPKOŚCI ROZTWORÓW NaI W MIESZANINACH WODY
Z IZOMERAMI BUTANOLU

Zmierzono lepkość roztworów NaI w mieszaninach wody z izobutanołem, sec-butanołem w temperaturze 298,15 K i tert-butanołem w temperaturze 299,15 K w całym zakresie składów mieszanego rozpuszczalnika. Pomiary wykonano w roztworach NaI o stężeniu: 0,5, 1,0 i 2,0 mole elektrolitu na 100 moli mieszanego rozpuszczalnika.

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ЗНАЧЕНИЯ КОЭФФИЦИЕНТОВ ВЯЗКОСТИ РАСТВОРОВ NaI В СМЕСЯХ ВОДЫ
С ИЗОМЕРАМИ БУТАНОЛА

Определена вязкость растворов NaI в смесях воды с изобутанолом, втор-бутанолом при температуре 298,15° K и трет-бутанолом при температуре 299,15° K во всем диапазоне составов смешанного растворителя.

Измерения проведены для растворов NaI с концентрацией: 0,5, 1,0 и 2,0 мол. эл-та на 100 молей смешанного растворителя.