

*Stefania Taniowska-Osińska, Anna Kasperka*

VISCOSITY MEASUREMENTS OF NaI SOLUTIONS IN WATER-ISOPROPANOL  
MIXTURES AT SEVERAL TEMPERATURES

Viscosity of NaI solutions at concentrations: 0.5, 1.0 and 2.0 mol. of electrolyte per 100 mol. of the water-isopropanol mixed solvents has been measured over the whole composition range at the temperatures: 288.15, 298.15 and 313.15 K.

INTRODUCTION

This work follows investigations of physico-chemical properties of NaI-water monohydric alcohols systems which have been carried out for several years in our laboratory [1-5]. The aim of this paper is publishing the dates of the viscosity measurements of NaI solutions in isopropanol-water mixtures at the temperatures 288.15, 298.15 and 313.15 K. This results was exactly discussed in the paper published in "Polish Journal of Chemistry" [7].

EXPERIMENTAL

Reagents

NaI (by P. O. Ch. - Gliwice, p. a.) was crystallized from twice distilled water and dried at the temperature 333 K. Isopropanol (by P. O. Ch. - Gliwice p. a.) was dried by freshly

reasted calcium oxide and then distilled. Boiling fraction was collected at the temperature range 354.65-355.15 K. Water content in alcohol was determined by gas chromatography method. Solutions were prepared by weighing.

### Apparatus

The viscosity measurements were carried out using Ubbelohde's viscometers with the efflux time of the investigated solutions from 200 to 500 s. The efflux time was measured with accuracy to  $\pm 0.1$  s. In order to avoid solvent evaporation the viscometer was provided with a simple system enabling the measurements without any contact with atmosphere [1]. Density was measured using Lipkin's picnometers of approximately 14 cm<sup>3</sup> capacity. Viscometers and picnometers were thermostated with precision to  $\pm 0.02^\circ$ . They were calibrated by double-distilled water. Table values of density and viscosity of water at the investigated temperatures were taken [6].

Maximum value of mean square error of density measurements does not exceed  $1.10^{-4}$  g/cm<sup>3</sup>, and of viscosity measurements  $3.10^{-3}$  cp.

### RESULTS

The measured viscosity values,  $\eta_0$ , of water-isopropanol mixture and viscosity of NaI solutions,  $\eta$ , in these mixtures at the temperatures 288.15, 298.15 and 315.15 K are presented in tab. 1-3.

The discussion of the results of viscosity measurements of NaI water-alcohol solutions was published in "Polish Journal of Chemistry", 53, 1351 (1979).

Table 1

Viscosity and density of NaI solutions in water-isopropanol mixtures at 288.15 K,  
 c-salt concentration, in moles per 100 mol. of solvent,  $x_2^s$  - molar percentage of alcohol

$x_2^s$	c = 0		c = 0.5		c = 1.0		c = 2.0	
	$\rho_0/g\text{ cm}^{-3}$	$\eta_0/cP$	$\rho/g\text{ cm}^{-3}$	$\eta/cP$	$\rho/g\text{ cm}^{-3}$	$\eta/cP$	$\rho/g\text{ cm}^{-3}$	$\eta/cP$
0.0	0.9991	1.138	1.0311	1.154	1.0618	1.156	1.1217	1.154
1.5	0.9909	1.490	1.0212	1.480	1.0509	1.475	1.1083	1.467
5.0	0.9778	2.514	1.0031	2.443	1.0323	2.389	1.0843	2.329
7.5	0.9701	3.311	0.9955	3.174	1.0204	3.082	1.0688	2.916
10.0	0.9606	3.803	0.9844	3.611	1.0079	3.540	1.0532	3.344
15.0	0.9403	4.484	0.9615	4.347	0.9823	4.224	1.0231	4.038
20.0	0.9210	4.658	0.9402	4.570	0.9592	4.475	0.9968	4.360
25.0	0.9040	4.730	0.9218	4.674	0.9393	4.629	0.9735	4.558
30.0	0.8895	4.640	0.9061	4.621	0.9221	4.599	0.9537	4.589
40.0	0.8655	4.280	0.8799	4.317	0.8939	4.349	0.9218	4.423
50.0	0.8470	3.875	0.8596	3.970	0.8721	4.034	0.8965	4.177
60.0	0.8314	3.491	0.8428	3.611	0.8538	3.708	0.8756	3.897
70.0	0.8186	3.181	0.8289	3.320	0.8391	3.432	0.8589	3.647
80.0	0.8076	2.949	0.8172	3.130	0.8264	3.262	0.8448	3.516
85.0	0.8027	2.867	0.8121	3.055	0.8211	3.201	0.8388	3.481
90.0	0.7986	2.823	0.8075	3.018	0.8162	3.185	0.8331	3.488
92.5	0.7960	2.815	0.8047	3.030	0.8135	3.200	0.8309	3.521
95.0	0.7937	2.814	0.8023	3.034	0.8108	3.218	0.8273	3.556
97.5	0.7914	2.830	0.7998	3.051	0.8084	3.249	0.8248	3.600
100.0	0.7993	2.845	0.7975	3.096	0.8062	3.275	0.8228	3.632

Viscosity and density of NaI solutions in water-isopropanol mixtures at 298.15 K,  
 c - salt concentration, in moles per 100 mol. of solvent,  $x_2$  % - molar percentage of alcohol

$x_2$ %	c = 0		c = 0.5		c = 1.0		c = 2.0	
	$\rho_0$ /g cm <sup>-3</sup>	$\eta_0$ /cP	$\rho$ /g cm <sup>-3</sup>	$\eta$ /cP	$\rho$ /g cm <sup>-3</sup>	$\eta$ /cP	$\rho$ /g cm <sup>-3</sup>	$\eta$ /cP
0.0	0.89707	0.8903	1.0285	0.8959	1.0589	0.9016	1.1179	0.9190
1.5	0.9886	1.112	1.0187	1.113	1.0479	1.122	1.1044	1.127
5.0	0.9743	1.747	1.0015	1.725	1.0281	1.706	1.0796	1.680
7.5	0.9645	2.181	0.9899	2.147	1.0153	2.104	1.0632	2.050
10.0	0.9544	2.491	0.9781	2.439	1.0014	2.395	1.0466	2.335
15.0	0.9331	2.883	0.9546	2.845	0.9752	2.803	1.0156	2.756
20.0	0.9129	3.008	0.9325	2.990	0.9514	2.970	0.9892	2.944
25.0	0.8966	3.057	0.9143	3.059	0.9317	3.052	0.9660	3.063
30.0	0.8811	3.026	0.8977	3.053	0.9137	3.063	0.9453	3.100
40.0	0.8569	2.855	0.8710	2.909	0.8855	2.948	0.9125	3.026
50.0	0.8378	2.631	0.8505	2.709	0.8633	2.766	0.8876	2.878
60.0	0.8225	2.411	0.8338	2.505	0.8449	2.576	0.8674	2.718
70.0	0.8094	2.230	0.8199	2.337	0.8300	2.430	0.8499	2.583
80.0	0.7986	2.098	0.8079	2.224	0.8175	2.319	0.8360	2.508
85.0	0.7939	2.056	0.8031	2.193	0.8124	2.297	0.8299	2.502
90.0	0.7891	2.030	0.7982	2.175	0.8073	2.293	0.8241	2.515
92.5	0.7872	2.026	0.7962	2.179	0.8050	2.296	0.8224	2.527
95.0	0.7851	2.031	0.7939	2.186	0.8026	2.312	0.8189	2.551
97.5	0.7829	2.036	0.7916	2.196	0.8000	2.327	0.8167	2.576
100.0	0.7814	2.074	0.7900	2.235	0.7983	2.366	0.8149	2.625



Viscosity and density of NaI solutions in water-isopropanol mixtures at 313.15 K,  
 c-salt concentration, in moles per 100 mol. of solvent,  $x_2^{\%}$  - molar percentage of alcohol

$x_2^{\%}$	c = 0		c = 0.5		c = 1.0		c = 2.0	
	$\rho_0/g\text{ cm}^{-3}$	$\eta_0/cP$	$\rho/g\text{ cm}^{-3}$	$\eta/cP$	$\rho/g\text{ cm}^{-3}$	$\eta/cP$	$\rho/g\text{ cm}^{-3}$	$\eta/cP$
0.0	0.9922	0.6531	1.0229	0.6630	1.0531	0.6739	1.1110	0.6905
1.5	0.9838	0.7848	1.0131	0.7927	1.0421	0.7991	1.0976	0.8176
5.0	0.9671	1.113	0.9939	1.114	1.0202	1.115	1.0710	1.123
7.5	0.9560	1.292	0.9811	1.294	1.0056	1.294	1.0530	1.301
10.0	0.9439	1.453	0.9677	1.452	0.9905	1.452	1.0358	1.457
15.0	0.9211	1.665	0.9422	1.674	0.9631	1.679	1.0055	1.692
20.0	0.9008	1.777	0.9203	1.793	0.9395	1.809	0.9760	1.831
25.0	0.8838	1.823	0.9015	1.848	0.9187	1.868	0.9528	1.907
30.0	0.8688	1.822	0.8853	1.860	0.9011	1.883	0.9327	1.932
40.0	0.8443	1.756	0.8585	1.799	0.8726	1.842	0.8996	1.906
50.0	0.8247	1.649	0.8373	1.703	0.8496	1.748	0.8741	1.832
60.0	0.8093	1.539	0.8207	1.597	0.8319	1.653	0.8537	1.750
70.0	0.7965	1.446	0.8069	1.515	0.8170	1.574	0.8368	1.683
80.0	0.7856	1.375	0.7953	1.454	0.8046	1.517	0.8230	1.640
85.0	0.7809	1.350	0.7903	1.433	0.7993	1.500	0.8170	1.632
90.0	0.7754	1.327	0.7856	1.415	0.7933	1.489	0.8106	1.635
92.4	0.7741	1.331	0.7831	1.422	0.7912	1.501	0.8086	1.644
95.0	0.7718	1.332	0.7808	1.425	0.7893	1.501	0.8060	1.651
97.5	0.7697	1.336	0.7784	1.432	0.7867	1.507	0.8033	1.663
100.0	0.7680	1.340	0.7763	1.433	0.7847	1.513	0.8011	1.672

## REFERENCES

- [1] Taniewska-Osińska S., Chądzyński P., ZNUE, S. II (6), 37 (1976).
- [2] Taniewska-Osińska S., Piekarski H., Kacperska A., *Thermodynamica i stroyenie rastvorov*, 123, Ivanovo (1976).
- [3] Taniewska-Osińska S., Piekarski H., Witkowski S., *Proceedings of IV Intern. Conf. Calorimetry and Thermodynamics*, p. 151, Montpellier, France (1975).
- [4] Taniewska-Osińska S., Piekarski H., Zhurn. Obsh. Khim., 44 (8), 1665 (1974).
- [5] Taniewska-Osińska S., Grochowski R., Pałecz B., *Wiss. Z. Th. Leuna-Merseburg*, 17 (3), 547 (1975).
- [6] Stokes R. H., R. Mills, *The International Encyclopedia of Physical Chemistry and Chemical Physics*, ed. R. H. Stokes, London Edinburgh, New York, Paris, Frankfurt, 3 (1965).
- [7] Taniewska-Osińska S., Kacperska A., *Pol. J. Chem.*, 53, 1351 (1979).

Institute of Chemistry  
University of Łódź

*Stefania Taniewska-Osińska, Anna Kacperska*

POMIARY LEPKOŚCI ROZTWORÓW NaI W MIESZANINIE WODA-IZOPROPANOL  
W KILKU TEMPERATURACH

Zmierzono lepkość wodno-izopropanolowych roztworów NaI w całym zakresie składów mieszanego rozpuszczalnika w temperaturach 288.15, 298.15 i 313.15 K. Pomiary wykonano w roztworach NaI o stężeniu: 0.5, 1.0 i 2.0 mole elektrolitu na 100 moli mieszanego rozpuszczalnika. Uzyskane wyniki lepkości zebrano w tab. 1-3.

• Стефания Таневска-Осииска, Анна Кацперска

ИЗМЕРЕНИЯ ВЯЗКОСТИ РАСТВОРОВ NaI В СМЕСИ ВОДА-ИЗОПРОПАНОЛ  
В НЕСКОЛЬКИХ ТЕМПЕРАТУРАХ

Определена вязкость растворов NaI во всем диапазоне составов смешанного растворителя вода-изопропанол при температурах 288,15, 298,15 и 313,15 К. Измерения проведены для растворов NaI с концентрацией: 0,5, 1,0 и 2,0 моль зл-та на 100 моль смешанного растворителя. Полученные значения вязкости помещены в таблицах 1-3.