Density, Refractive Index, and Speed of Sound of Binary Mixtures (Diethyl Carbonate + Alcohols) at Several Temperatures

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Density, ρ; refractive index on mixing, n_D; and speed of sound, u; at 293.15 K, 298.15 K, 303.15 K, and 313.15 K and atmospheric pressure have been measured for binary mixtures of diethyl carbonate (DEC) + methanol, ethanol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, or 1-pentanol. Excess molar volumes, V^E; changes of refractive index on mixing, Δn_D; and deviations in isentropic compressibility, $\Delta\kappa_S$; for the above systems have been calculated. The Redlich−Kister equation has been used to estimate the binary fitting parameters, and root-mean-square deviations from the regression lines are shown. The V^E values were fitted as a function of the mole fraction and temperature to a polynomial equation.

Introduction

Densities, ρ; refractive indices, n_D; and speeds of sound of homogeneous binary mixtures from 293.15 K to 313.15 K and atmospheric pressure have been measured as a continuation of the thermodynamic study[1−3] of the mixture containing esters of carbonic acid due to the considerable interest in their uses in industry for the synthesis of many chemicals, in pharmaceuticals, and in agricultural chemistry.

The results were used to calculate excess molar volumes, changes of refractive index on mixing, and deviations in isentropic compressibility over the entire mole fraction range for the mixtures. Experimental values were correlated by the Redlich−Kister[4] equation. The root-mean-square deviations between experimental and calculated values are shown.

Comparison between experimental and literature data has been made. There are limited experimental data available in the literature for the systems studied. There are density[5] data for diethyl carbonate + methanol, ethanol, 1-propanol, or 1-butanol at 298.15 K.

Experimental Section

Materials. The pure components were supplied by Merck except diethyl carbonate and 1-pentanol, which were supplied by Fluka. They were degassed by ultrasound and dried over molecular sieves types (3 and 4) Å (supplied by Aldrich) and kept in an inert argon (with a maximum content in water of 2.14×10^{-6} by mass fraction) atmosphere. Their mass fraction purities were >99.5 mass % for diethyl carbonate, >99.8 mass % for methanol, >99.9 mass % for ethanol, >99.8 mass % for 1-propanol, >99.9 mass % for 2-propanol, >99.8 mass % for 1-butanol, >99.8 mass % for 2-butanol, and more than >99 mass % for 1-pentanol. The close comparison to recent published density and refractive index values, shown in Table 1, confirms their purity.

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Table 1. Comparison of Density ρ and Refractive Index n_D with Literature Data for Pure Components at 298.15 K

component	ρ/(g·cm^{-3}) exptl	ρ/(g·cm^{-3}) lit.	n_D exptl	n_D lit.
methanol	0.7866	0.78664[a,b]	1.32645	1.32652[a,b]
ethanol	0.7850	0.78509[a,b]	1.35922	1.35941[a,b]
1-propanol	0.7995	0.79975[a] 0.79960[b]	1.38307	1.38370[a,b]
2-propanol	0.7809	0.78126[b]	1.37521	1.37520[b]
1-butanol	0.8059	0.80575[b]	1.39702	1.39741[b]
2-butanol	0.8024	0.80241[b]	1.39523	1.39530[d]
1-pentanol	0.8109	0.81080[b]	1.40789	1.40800[b]
diethyl carbonate	0.9691	0.96926[b] 0.96924[c]	1.38240	1.38240[d] 1.38287[b]

[a] Das et al.[7] [b] Riddick et al.[8] [c] Francesconi et al.[5] [d] Cocero et al.[9]

Apparatus and Procedure. The mixtures were prepared by mass by syringing pure liquids into stoppered bottles to prevent evaporation. A Mettler AT-261 Delta Range balance was used with a precision of $\pm 10^{-5}$ g. The density and the speed of sound of the pure liquids and mixtures were measured with an Anton Paar DSA-48 densimeter and sound analyzer with a precision of $\pm 10^{-4}$ g·cm^{-3} and ± 1 m·s^{-1}, respectively. The refractive index was measured by automatic refractometer ABBEMAT-HP Dr. Kernchen with a precision of $\pm 10^{-5}$. Before measurements were taken, these instruments were calibrated with Millipore quality water and ambient air, respectively, in accordance with the instructions. The accuracy in the calculation of excess volumes, changes of refractive index on mixing, and excess isentropic compressibilities were estimated as better than 10^{-2} cm^3·mol^{-1}, 5×10^{-5}, and 2 TPa^{-1}, respectively.

Results

Density, ρ; refractive index, n_D; speed of sound, u; excess molar volume, V^E; change of refractive index on mixing, Δn_D; isentropic compressibility, κ_S (determined by means of the Laplace equation, $\kappa_S = \rho^{-1}u^{-2}$); and deviation in

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Table 2. Density ρ, Refractive Index n_D, Excess Molar Volume V_m^E, Change of Refractive Index on Mixing Δn_D, Speed of Sound u, Isentropic Compressibility κ_S, and Deviation in Isentropic Compressibility $\Delta\kappa_S$ for Binary Mixtures at Several Temperatures

x	ρ/(g·cm^{-3})	n_D	u/(m·s^{-1})	V_m^E/(cm^3·mol^{-1})	Δn_D	κ_S/(TPa^{-1})	$\Delta\kappa_S$/(TPa^{-1})
Diethyl Carbonate (1) + Methanol (2)							
T = 293.15 K							
0	0.7912	1.32843	1119	0	0	1009	0
0.0513	0.8172	1.33638	1127	−0.023	0.0051	963	−31
0.1002	0.8378	1.34288	1136	−0.043	0.0089	925	−55
0.1972	0.8699	1.35297	1148	−0.061	0.0135	872	−80
0.2839	0.8918	1.35979	1157	−0.073	0.0155	838	−89
0.4038	0.9150	1.36680	1166	−0.074	0.0158	804	−87
0.5000	0.9295	1.37116	1171	−0.066	0.0148	784	−79
0.5933	0.9411	1.37469	1175	−0.056	0.0132	769	−66
0.6417	0.9464	1.37618	1178	−0.054	0.0120	761	−61
0.7996	0.9608	1.38072	1190	−0.031	0.0077	735	−41
0.9014	0.9683	1.38288	1195	−0.009	0.0042	723	−23
0.9709	0.9729	1.38384	1196	−0.003	0.0012	718	−7
1	0.9747	1.38422	1196	0	0	717	0
T = 298.15 K							
0	0.7866	1.32645	1102	0	0	1047	0
0.0496	0.8116	1.33415	1109	−0.019	0.0049	1001	−31
0.0996	0.8326	1.34071	1117	−0.036	0.0087	962	−55
0.1985	0.8652	1.35090	1131	−0.060	0.0133	904	−83
0.2944	0.8889	1.35818	1140	−0.070	0.0153	866	−92
0.4014	0.9093	1.36443	1147	−0.072	0.0155	837	−90
0.4975	0.9238	1.36881	1153	−0.066	0.0145	814	−83
0.6068	0.9372	1.37274	1158	−0.056	0.0123	795	−69
0.7087	0.9475	1.37602	1165	−0.046	0.0099	777	−57
0.8365	0.9581	1.37925	1171	−0.021	0.0060	761	−35
0.9091	0.9633	1.38086	1174	−0.012	0.0035	753	−21
0.9598	0.9666	1.38175	1175	−0.002	0.0016	749	−9
1	0.9691	1.38240	1176	0	0	746	0
T = 303.15 K							
0	0.7818	1.3241	1086	0	0	1085	0
0.0490	0.8065	1.33187	1093	−0.025	0.0050	1039	−31
0.0966	0.8265	1.3382	1100	−0.040	0.0087	1000	−55
0.1958	0.8592	1.34849	1112	−0.057	0.0134	941	−83
0.2824	0.8809	1.35512	1122	−0.066	0.0152	902	−96
0.3914	0.9021	1.36186	1129	−0.065	0.0159	870	−94
0.4936	0.9177	1.36654	1134	−0.059	0.0148	847	−86
0.5810	0.9286	1.36979	1138	−0.045	0.0132	831	−75
0.6945	0.9404	1.37336	1143	−0.029	0.0104	814	−57
0.7349	0.9441	1.37443	1146	−0.026	0.0092	807	−52
0.8512	0.9535	1.37685	1152	−0.014	0.0051	791	−32
0.9214	0.9584	1.37812	1153	−0.004	0.0025	785	−17
1	0.9634	1.38004	1156	0	0	777	0
T = 313.15 K							
0	0.7726	1.32048	1054	0	0	1166	0
0.0509	0.7976	1.32802	1062	−0.009	0.0048	1111	−38
0.0999	0.8175	1.33422	1071	−0.008	0.0083	1067	−67
0.2009	0.8500	1.34460	1084	−0.021	0.0131	1002	−99
0.2981	0.8735	1.35200	1091	−0.031	0.0152	962	−108
0.4009	0.8928	1.35799	1095	−0.036	0.0156	935	−102
0.5056	0.9083	1.36257	1098	−0.032	0.0144	914	−89
0.6062	0.9204	1.36608	1101	−0.024	0.0124	897	−74
0.7033	0.9301	1.36873	1106	−0.010	0.0098	880	−60
0.8055	0.9388	1.37138	1112	−0.001	0.0068	862	−45
0.9020	0.9459	1.37336	1115	0.001	0.0035	851	−25
0.9448	0.9487	1.37416	1115	0.008	0.0020	847	−15
1	0.9522	1.37518	1115	0	0	844	0
Diethyl Carbonate (1) + Ethanol (2)							
T = 293.15 K							
0	0.7893	1.36125	1160	0	0	941	0
0.0503	0.8076	1.36362	1163	0.004	0.0012	916	−14
0.0997	0.8238	1.36555	1166	0.013	0.0020	893	−26
0.1980	0.8518	1.36910	1171	0.027	0.0033	856	−41
0.3006	0.8762	1.37205	1174	0.046	0.0039	829	−45
0.4031	0.8968	1.37480	1177	0.067	0.0043	805	−46
0.5031	0.9141	1.37692	1179	0.083	0.0041	786	−42
0.6063	0.9296	1.37880	1183	0.098	0.0036	769	−36
0.6898	0.9407	1.38019	1185	0.107	0.0031	757	−30
0.8066	0.9546	1.38199	1190	0.104	0.0022	740	−21
0.8950	0.9642	1.38320	1193	0.070	0.0014	728	−12
0.9450	0.9693	1.38372	1195	0.042	0.0008	722	−7
1	0.9747	1.38422	1196	0	0	717	0

Table 2. (Continued)

x	ρ/(g·cm^{-3})	n_D	u/(m·s^{-1})	V_m^E/(cm^3·mol^{-1})	Δn_D	κ_S/(TPa^{-1})	$\Delta\kappa_S$/(TPa^{-1})
			T = 298.15 K				
0	0.7850	1.35922	1142	0	0	977	0
0.0496	0.8029	1.36152	1146	0.008	0.0012	949	−16
0.0973	0.8184	1.36327	1148	0.022	0.0018	928	−26
0.1963	0.8464	1.36677	1151	0.047	0.0030	892	−40
0.2985	0.8706	1.36981	1154	0.069	0.0037	863	−45
0.3980	0.8905	1.37223	1157	0.097	0.0038	840	−45
0.5057	0.9091	1.37461	1160	0.109	0.0037	818	−42
0.6032	0.9237	1.37637	1163	0.117	0.0032	801	−37
0.7035	0.9369	1.37803	1166	0.126	0.0025	785	−29
0.7999	0.9484	1.37935	1170	0.105	0.0016	771	−21
0.8989	0.9590	1.38096	1173	0.078	0.0009	758	−12
0.9283	0.9621	1.38133	1174	0.049	0.0006	754	−9
1	0.9691	1.38240	1176	0	0	746	0
			T = 303.15 K				
0	0.7807	1.35680	1126	0	0	1011	0
0.0491	0.7983	1.35912	1129	0.008	0.0012	983	−16
0.0984	0.8142	1.36116	1130	0.022	0.0021	961	−27
0.1952	0.8413	1.36463	1133	0.053	0.0033	926	−39
0.2961	0.8650	1.36744	1136	0.082	0.0038	897	−45
0.3946	0.8847	1.36979	1138	0.105	0.0038	873	−45
0.4859	0.9005	1.37188	1140	0.126	0.0038	854	−43
0.5995	0.9177	1.37385	1143	0.133	0.0031	833	−37
0.6959	0.9305	1.37557	1146	0.128	0.0026	818	−31
0.7862	0.9413	1.37705	1149	0.111	0.0020	804	−23
0.8911	0.9527	1.37860	1153	0.067	0.0011	789	−13
0.9254	0.9562	1.37903	1154	0.046	0.0007	785	−10
1	0.9634	1.38004	1156	0	0	777	0
			T = 313.15 K				
0	0.7721	1.35303	1093	0	0	1084	0
0.0499	0.7897	1.35501	1095	0.009	0.0009	1056	−16
0.1020	0.8061	1.35703	1096	0.033	0.0017	1033	−27
0.2038	0.8339	1.36036	1098	0.066	0.0028	996	−40
0.3116	0.8585	1.36315	1099	0.086	0.0032	965	−45
0.4001	0.8755	1.36532	1100	0.122	0.0034	943	−45
0.4971	0.8918	1.36725	1102	0.150	0.0032	923	−42
0.6023	0.9072	1.36924	1105	0.172	0.0029	903	−36
0.7058	0.9205	1.37077	1107	0.185	0.0021	886	−29
0.8065	0.9321	1.37246	1110	0.175	0.0016	870	−21
0.9022	0.9424	1.37383	1113	0.109	0.0008	856	−12
0.9518	0.9475	1.37448	1115	0.053	0.0004	849	−6
1	0.9522	1.37518	1115	0	0	844	0
			Diethyl Carbonate (1) + 1-Propanol (2)				
			T = 293.15 K				
0	0.8034	1.38494	1223	0	0	832	0
0.0504	0.8168	1.38477	1219	0.016	−0.0001	824	−3
0.1007	0.8293	1.38463	1216	0.039	−0.0002	816	−5
0.2008	0.8521	1.38415	1210	0.085	−0.0006	802	−7
0.3019	0.8725	1.38402	1205	0.150	−0.0007	789	−8
0.4004	0.8908	1.38380	1201	0.170	−0.0009	778	−8
0.5039	0.9082	1.38380	1198	0.190	−0.0008	767	−8
0.6031	0.9235	1.38394	1197	0.191	−0.0006	756	−7
0.7007	0.9375	1.38398	1196	0.167	−0.0005	746	−6
0.7999	0.9506	1.38414	1196	0.140	−0.0002	735	−5
0.9132	0.9647	1.38428	1197	0.062	0.0000	724	−3
0.9531	0.9694	1.38434	1197	0.031	0.0001	720	−2
1	0.9747	1.38422	1196	0	0	717	0
			T = 298.15 K				
0	0.7995	1.38307	1206	0.000	0.0000	860	0
0.0515	0.8127	1.38281	1201	0.050	−0.0002	852	−1
0.0993	0.8244	1.38259	1198	0.080	−0.0004	845	−3
0.2012	0.8473	1.38227	1191	0.138	−0.0007	832	−5
0.3007	0.8674	1.38215	1186	0.183	−0.0007	819	−6
0.4026	0.8860	1.38205	1182	0.219	−0.0008	808	−6
0.5022	0.9026	1.38197	1179	0.236	−0.0008	797	−6
0.6029	0.9180	1.38189	1177	0.238	−0.0008	786	−5
0.7041	0.9324	1.38190	1177	0.208	−0.0007	775	−5
0.8087	0.9461	1.38201	1176	0.168	−0.0005	764	−4
0.9065	0.9581	1.38215	1176	0.105	−0.0003	754	−3
0.9523	0.9636	1.38226	1176	0.052	−0.0002	750	−2
1	0.9691	1.38240	1176	0	0	746	0

Table 2. (Continued)

x	ρ/(g·cm^{-3})	n_D	u/(m·s^{-1})	V_m^E/(cm^3·mol^{-1})	Δn_D	κ_S/(TPa^{-1})	$\Delta\kappa_S$/(TPa^{-1})
			T = 303.15 K				
0	0.7955	1.38104	1189	0	0	889	0
0.0464	0.8073	1.38070	1185	0.047	−0.0003	883	−1
0.0963	0.8194	1.38035	1181	0.084	−0.0006	875	−3
0.1968	0.8418	1.37987	1174	0.149	−0.0010	862	−5
0.2981	0.8621	1.37951	1168	0.199	−0.0012	850	−5
0.3987	0.8804	1.37943	1164	0.229	−0.0012	839	−6
0.4958	0.8965	1.37931	1161	0.246	−0.0012	828	−5
0.5991	0.9123	1.37929	1158	0.237	−0.0012	817	−5
0.6967	0.9260	1.37928	1157	0.221	−0.0011	807	−4
0.8063	0.9403	1.37942	1157	0.175	−0.0008	795	−4
0.908	0.9527	1.37962	1157	0.104	−0.0005	784	−3
0.9448	0.9571	1.37977	1157	0.058	−0.0003	781	−2
1	0.9634	1.38004	1156	0	0	777	0
			T = 313.15 K				
0	0.7873	1.37676	1155	0	0	952	0
0.0500	0.7995	1.37626	1148	0.079	−0.0004	950	2
0.1018	0.8116	1.37594	1143	0.134	−0.0007	943	1
0.2001	0.8328	1.37526	1136	0.223	−0.0012	930	0
0.3017	0.8527	1.37497	1130	0.280	−0.0013	919	−1
0.3958	0.8696	1.37478	1126	0.300	−0.0014	907	−2
0.5040	0.8873	1.37470	1122	0.306	−0.0013	895	−2
0.6009	0.9017	1.37466	1119	0.309	−0.0012	885	−2
0.7032	0.9159	1.37458	1118	0.277	−0.0011	874	−2
0.7998	0.9284	1.37468	1116	0.221	−0.0008	864	−2
0.8997	0.9405	1.37481	1115	0.142	−0.0005	855	0
0.9468	0.9461	1.37506	1115	0.076	−0.0002	850	0
1	0.9522	1.37518	1115	0	0	844	0
			Diethyl Carbonate (1) + 2-Propanol (2)				
			T = 293.15 K				
0	0.7849	1.37702	1156	0	0	953	0
0.0502	0.7990	1.37737	1159	0.056	0.0000	932	−10
0.1001	0.8120	1.37764	1160	0.131	−0.0001	916	−14
0.2030	0.8373	1.37833	1162	0.219	−0.0002	884	−21
0.3012	0.8591	1.37901	1165	0.291	−0.0002	858	−24
0.3954	0.8783	1.37968	1168	0.337	−0.0002	835	−25
0.5021	0.8984	1.38050	1171	0.352	−0.0001	811	−24
0.6035	0.9160	1.38124	1176	0.342	−0.0001	790	−21
0.6976	0.9312	1.38190	1180	0.311	−0.0001	771	−17
0.8048	0.9474	1.38270	1186	0.246	−0.0001	751	−12
0.9129	0.9629	1.38356	1192	0.123	0.0000	731	−7
0.9529	0.9684	1.38394	1194	0.068	0.0001	724	−4
1	0.9747	1.38422	1196	0	0	717	0
			T = 298.15 K				
0	0.7809	1.37521	1139	0	0	987	0
0.0490	0.7942	1.37530	1140	0.090	−0.0003	969	−7
0.0987	0.8072	1.37550	1141	0.153	−0.0004	951	−12
0.1978	0.8312	1.37604	1143	0.264	−0.0006	920	−19
0.2945	0.8527	1.37666	1146	0.329	−0.0007	893	−23
0.3925	0.8726	1.37730	1149	0.378	−0.0007	869	−24
0.4925	0.8913	1.37798	1152	0.403	−0.0008	846	−23
0.5939	0.9088	1.37871	1156	0.405	−0.0008	824	−20
0.7004	0.9259	1.37957	1160	0.373	−0.0007	802	−16
0.7979	0.9406	1.38041	1166	0.306	−0.0005	783	−12
0.8967	0.9548	1.38132	1171	0.189	−0.0003	764	−7
0.9504	0.9623	1.38181	1174	0.099	−0.0002	754	−4
1	0.9691	1.38240	1176	0	0	746	0
			T = 303.15 K				
0	0.7766	1.37261	1122	0	0	1023	0
0.0522	0.7906	1.37277	1122	0.100	−0.0002	1005	−6
0.0990	0.8027	1.37297	1123	0.163	−0.0004	988	−11
0.1944	0.8257	1.37359	1124	0.268	−0.0005	958	−17
0.2913	0.8470	1.37434	1126	0.351	−0.0004	931	−21
0.3920	0.8673	1.37502	1129	0.406	−0.0005	905	−22
0.4763	0.8831	1.37559	1132	0.423	−0.0006	884	−22
0.5883	0.9025	1.37631	1136	0.423	−0.0007	859	−19
0.6972	0.9199	1.37706	1140	0.393	−0.0007	836	−16
0.7854	0.9333	1.37782	1145	0.318	−0.0006	817	−12
0.8890	0.9482	1.37873	1150	0.193	−0.0005	797	−8
0.9488	0.9565	1.37939	1153	0.094	−0.0003	786	−4
1	0.9634	1.38004	1156	0	0	777	0

Table 2. (Continued)

x	ρ/(g·cm^{-3})	n_D	u/(m·s^{-1})	V_m^E/(cm^3·mol^{-1})	Δn_D	κ_S/(TPa^{-1})	$\Delta\kappa_S$/(TPa^{-1})
			T = 313.15 K				
0	0.7678	1.36821	1086	0	0	1104	0
0.0506	0.7811	1.36824	1086	0.110	−0.0003	1085	−6
0.0997	0.7933	1.36834	1086	0.212	−0.0006	1069	−9
0.2016	0.8172	1.36875	1087	0.353	−0.0009	1037	−15
0.3030	0.8390	1.36944	1088	0.442	−0.0009	1007	−19
0.4008	0.8582	1.37012	1091	0.506	−0.0009	980	−20
0.4969	0.8759	1.37077	1093	0.510	−0.0009	955	−20
0.5990	0.8932	1.37148	1097	0.502	−0.0009	930	−18
0.7007	0.9093	1.37229	1101	0.456	−0.0008	907	−15
0.8011	0.9243	1.37304	1105	0.365	−0.0008	885	−11
0.9030	0.9388	1.3739	1110	0.216	−0.0006	864	−5
0.9511	0.9455	1.37456	1113	0.117	−0.0003	855	−2
1	0.9522	1.37518	1115	0	0	844	0
			Diethyl Carbonate (1) + 1-Butanol (2)				
			T = 293.15 K				
0	0.8095	1.39924	1257	0	0	782	0
0.0510	0.8201	1.39813	1251	0.043	−0.0003	780	1
0.1027	0.8305	1.39717	1244	0.085	−0.0005	778	2
0.2008	0.8493	1.39509	1234	0.164	−0.0011	774	5
0.2978	0.8670	1.39321	1225	0.220	−0.0016	769	6
0.4026	0.8853	1.39133	1217	0.245	−0.0019	762	7
0.5079	0.9027	1.38959	1211	0.257	−0.0020	756	7
0.6014	0.9175	1.38827	1206	0.247	−0.0019	749	6
0.7033	0.9329	1.38718	1203	0.225	−0.0015	741	5
0.7986	0.9468	1.38617	1201	0.178	−0.0011	733	3
0.9031	0.9616	1.38525	1199	0.088	−0.0004	724	0
0.9510	0.9681	1.38481	1198	0.050	−0.0001	720	0
1	0.9747	1.38422	1196	0	0	717	0
			T = 298.15 K				
0	0.8059	1.39702	1241	0	0	806	0
0.0519	0.8162	1.39593	1234	0.085	−0.0003	805	2
0.0993	0.8255	1.39495	1228	0.139	−0.0006	804	3
0.1996	0.8445	1.39292	1216	0.225	−0.0012	800	6
0.2923	0.8614	1.39110	1208	0.261	−0.0016	796	7
0.3989	0.8798	1.38933	1199	0.292	−0.0019	790	8
0.5017	0.8967	1.38768	1193	0.297	−0.0020	784	8
0.6016	0.9124	1.38636	1187	0.280	−0.0019	777	7
0.7043	0.9278	1.38512	1184	0.248	−0.0016	769	5
0.8002	0.9416	1.38412	1181	0.200	−0.0012	761	3
0.8968	0.9550	1.38326	1179	0.132	−0.0006	753	1
0.9471	0.9619	1.38281	1178	0.075	−0.0004	749	0
1	0.9691	1.38240	1176	0	0	746	0
			T = 303.15 K				
0	0.8018	1.39521	1224	0	0	833	0
0.0508	0.8120	1.39376	1216	0.059	−0.0007	832	2
0.1004	0.8217	1.39263	1210	0.109	−0.0011	832	4
0.2016	0.8407	1.39043	1198	0.193	−0.0017	829	7
0.3000	0.8583	1.38858	1188	0.245	−0.0021	825	9
0.3917	0.8739	1.38691	1181	0.280	−0.0024	820	9
0.5032	0.8920	1.38527	1173	0.295	−0.0023	814	9
0.5970	0.9066	1.38402	1169	0.280	−0.0021	808	8
0.7099	0.9233	1.38260	1164	0.252	−0.0018	799	6
0.8216	0.9392	1.38123	1161	0.183	−0.0015	790	3
0.9035	0.9505	1.38071	1159	0.108	−0.0008	784	1
0.9488	0.9567	1.38031	1157	0.048	−0.0005	780	0
1	0.9634	1.38004	1156	0	0	777	0
			T = 313.15 K				
0	0.7941	1.39090	1190	0	0	889	0
0.0506	0.8037	1.38970	1181	0.102	−0.0004	892	5
0.1007	0.8132	1.38843	1172	0.163	−0.0009	895	10
0.2005	0.8314	1.38615	1160	0.265	−0.0016	894	14
0.2975	0.8483	1.38428	1150	0.330	−0.0019	892	16
0.4122	0.8674	1.38212	1142	0.362	−0.0023	885	14
0.5035	0.8818	1.38061	1136	0.377	−0.0024	879	12
0.6084	0.8978	1.37910	1131	0.352	−0.0022	871	9
0.7044	0.9118	1.37795	1126	0.310	−0.0019	865	7
0.8055	0.9259	1.37697	1122	0.254	−0.0013	858	5
0.9016	0.9390	1.37602	1119	0.154	−0.0007	851	2
0.9486	0.9454	1.37559	1117	0.079	−0.0004	848	2
1	0.9522	1.37518	1115	0	0	844	0

Table 2. (Continued)

x	ρ/(g·cm^{-3})	n_D	u/(m·s^{-1})	V_m^E/(cm^3·mol^{-1})	Δn_D	κ_S/(TPa^{-1})	$\Delta\kappa_S$/(TPa^{-1})
Diethyl Carbonate (1) + 2-Butanol (2)							
T = 293.15 K							
0	0.8067	1.39722	1230	0	0	819	0
0.0512	0.8166	1.39579	1223	0.145	−0.0008	819	5
0.1031	0.8267	1.39469	1218	0.243	−0.0012	816	8
0.2021	0.8453	1.39276	1209	0.402	−0.0018	809	11
0.2997	0.8631	1.39087	1203	0.492	−0.0025	801	13
0.4023	0.8811	1.38930	1198	0.542	−0.0027	791	13
0.5115	0.8993	1.38773	1196	0.576	−0.0028	778	11
0.6070	0.9148	1.38667	1195	0.549	−0.0027	766	8
0.7070	0.9305	1.38578	1194	0.488	−0.0022	754	7
0.8038	0.9453	1.38499	1195	0.386	−0.0018	741	4
0.9089	0.9611	1.38445	1196	0.213	−0.0010	727	1
0.9524	0.9676	1.38433	1197	0.120	−0.0005	722	0
1	0.9747	1.38422	1196	0	0	717	0
T = 298.15 K							
0	0.8024	1.39523	1212	0	0	849	0
0.0509	0.8122	1.39374	1205	0.141	−0.0008	847	4
0.1010	0.8217	1.39257	1200	0.258	−0.0014	845	7
0.2020	0.8405	1.39035	1191	0.426	−0.0023	839	11
0.3002	0.8582	1.38864	1184	0.526	−0.0027	831	13
0.4040	0.8762	1.38720	1179	0.584	−0.0028	821	14
0.5003	0.8923	1.38593	1176	0.598	−0.0029	810	13
0.6008	0.9086	1.38489	1174	0.566	−0.0026	798	11
0.6963	0.9236	1.38392	1174	0.500	−0.0024	786	9
0.7987	0.9392	1.38313	1174	0.391	−0.0019	772	6
0.8999	0.9543	1.38261	1175	0.229	−0.0011	759	3
0.9466	0.9612	1.38238	1176	0.133	−0.0007	752	0
1	0.9691	1.38240	1176	0	0	746	0
T = 303.15 K							
0	0.7984	1.39288	1195	0	0	877	0
0.0517	0.8084	1.39157	1189	0.126	−0.0006	875	3
0.1132	0.8200	1.39012	1182	0.259	−0.0013	872	6
0.2267	0.8407	1.38783	1172	0.445	−0.0021	865	11
0.3316	0.8591	1.38599	1166	0.552	−0.0026	857	13
0.4467	0.8786	1.38429	1160	0.598	−0.0029	846	13
0.5422	0.8942	1.38288	1157	0.592	−0.0030	836	13
0.6426	0.9101	1.38202	1155	0.542	−0.0026	824	11
0.7416	0.9253	1.38126	1154	0.454	−0.0021	812	9
0.8281	0.9383	1.38059	1154	0.337	−0.0017	800	6
0.9196	0.9517	1.38019	1155	0.184	−0.0009	788	2
0.9494	0.9561	1.38023	1155	0.114	−0.0005	783	1
1	0.9634	1.38004	1156	0	0	777	0
T = 313.15 K							
0	0.7895	1.38818	1157	0	0	946	0
0.0511	0.7989	1.38670	1150	0.167	−0.0008	947	6
0.1026	0.8083	1.38533	1143	0.306	−0.0015	946	11
0.1988	0.8256	1.38320	1133	0.492	−0.0024	943	18
0.2955	0.8425	1.38132	1126	0.612	−0.0030	937	21
0.4041	0.8608	1.37956	1120	0.690	−0.0034	926	21
0.5084	0.8779	1.37826	1116	0.691	−0.0033	914	20
0.5983	0.8921	1.37726	1115	0.664	−0.0031	902	17
0.6988	0.9076	1.37644	1114	0.581	−0.0027	888	13
0.8034	0.9233	1.37593	1113	0.446	−0.0018	874	10
0.9022	0.9379	1.37553	1115	0.254	−0.0009	858	4
0.9523	0.9453	1.37528	1114	0.125	−0.0005	853	4
1	0.9522	1.37518	1115	0	0	844	0
Diethyl Carbonate (1) + 1-Pentanol (2)							
T = 293.15 K							
0	0.8142	1.40986	1292	0	0	736	0
0.0496	0.8228	1.40825	1286	0.034	−0.0003	735	0
0.1016	0.8316	1.40653	1278	0.084	−0.0007	736	2
0.2034	0.8486	1.40326	1263	0.168	−0.0014	739	7
0.3124	0.8665	1.40010	1249	0.235	−0.0017	740	10
0.3801	0.8775	1.39816	1241	0.262	−0.0020	740	11
0.5085	0.8981	1.39488	1228	0.285	−0.0019	738	12
0.6047	0.9133	1.39258	1220	0.283	−0.0018	735	11
0.7068	0.9293	1.39020	1214	0.253	−0.0015	730	8
0.8058	0.9447	1.38821	1208	0.197	−0.0010	726	5
0.9058	0.9601	1.38610	1203	0.121	−0.0005	720	1
0.9521	0.9673	1.38517	1201	0.062	−0.0003	717	−1
1	0.9747	1.38422	1196	0	0	717	0

Table 2. (Continued)

x	ρ/(g·cm^{-3})	n_D	u/(m·s^{-1})	V^E_m/(cm^3·mol^{-1})	Δn_D	κ_S/(TPa^{-1})	$\Delta\kappa_S$/(TPa^{-1})
			T = 298.15 K				
0	0.8109	1.40789	1276	0	0	758	0
0.0459	0.8186	1.40609	1269	0.057	−0.0006	759	1
0.0984	0.8273	1.40433	1262	0.117	−0.0011	759	3
0.2067	0.8451	1.40103	1246	0.210	−0.0016	762	6
0.3012	0.8604	1.39823	1233	0.271	−0.0020	765	11
0.4002	0.8762	1.39563	1221	0.316	−0.0021	766	13
0.5091	0.8934	1.39284	1209	0.333	−0.0021	766	14
0.5884	0.9058	1.39086	1202	0.326	−0.0020	764	14
0.6988	0.9229	1.38826	1194	0.292	−0.0018	761	11
0.7986	0.9383	1.38606	1187	0.224	−0.0015	756	8
0.9133	0.9558	1.38381	1181	0.121	−0.0008	750	3
0.9663	0.9639	1.38294	1178	0.054	−0.0003	747	1
1	0.9691	1.3824	1176	0	0	746	0
			T = 303.15 K				
0	0.8070	1.40578	1259	0	0	782	0
0.0541	0.8158	1.40398	1249	0.086	−0.0004	786	4
0.0951	0.8225	1.40263	1242	0.135	−0.0007	788	7
0.1968	0.8390	1.39937	1226	0.232	−0.0013	793	12
0.2920	0.8542	1.39656	1213	0.304	−0.0017	795	15
0.3986	0.8711	1.39349	1200	0.345	−0.0020	797	17
0.4966	0.8865	1.39093	1190	0.351	−0.0021	796	17
0.5963	0.9020	1.38845	1181	0.333	−0.0020	794	15
0.6847	0.9156	1.38643	1175	0.298	−0.0017	791	13
0.7988	0.9329	1.38380	1168	0.236	−0.0014	786	8
0.8885	0.9465	1.38207	1163	0.150	−0.0008	782	4
0.9493	0.9558	1.38093	1159	0.063	−0.0004	779	1
1	0.9634	1.38004	1156	0	0	777	0
			T = 313.15 K				
0	0.7995	1.40160	1225	0	0	833	0
0.0505	0.8073	1.39990	1214	0.113	−0.0004	840	7
0.1009	0.8152	1.39825	1205	0.194	−0.0007	845	11
0.2038	0.8312	1.39482	1187	0.333	−0.0014	854	18
0.3044	0.8468	1.39167	1173	0.416	−0.0019	858	21
0.4054	0.8623	1.38870	1161	0.469	−0.0022	861	23
0.5077	0.8781	1.38607	1150	0.456	−0.0021	861	22
0.5969	0.8916	1.38382	1143	0.442	−0.0020	859	19
0.7100	0.9086	1.38118	1134	0.387	−0.0017	856	15
0.8100	0.9236	1.37900	1127	0.297	−0.0012	852	10
0.9036	0.9377	1.37710	1121	0.168	−0.0006	848	5
0.9537	0.9453	1.37616	1118	0.077	−0.0002	846	3
1	0.9522	1.37518	1115	0	0	844	0

isentropic compressibility, $\Delta\kappa_S$; are reported in Table 2. V^E, Δn_D, and $\Delta\kappa_S$, respectively, from

$$V^E = \sum_{i=1}^{N} x_i M_i(\rho^{-1} - \rho_i^{\circ\,-1}) \tag{1}$$

$$\Delta n_D = n_D - \sum_{i=1}^{N} x_i n_{Di}^{\circ} \tag{2}$$

$$\Delta\kappa_S = \kappa_S - \sum_{i=1}^{N} x_i \kappa_{S,i} \tag{3}$$

In these equations, ρ and n_D are the density and refractive index of the mixture, ρ_i° and n_{Di}° are the density and refractive index of pure components, κ_S is the isentropic compressibility of the mixture, and $\kappa_{S,i}$ is the isentropic compressibility of the pure component.

The binary values were fitted to a Redlich−Kister type equation

$$\Delta Q_{ij} = x_i x_j \sum_{p=0}^{M} B_p (x_i - x_j)^p \tag{4}$$

where ΔQ_{ij} is the excess property, x is the mole fraction, B_p is the fitting parameter, and M is the degree of the polynomic expansion. By applying the F test,[6] the degree of polynomial expression was optimized. The correlation parameters calculated using eqs 4 and 5 are listed in Table 3, together with the root-mean-square deviations (σ). This deviation is calculated by applying the expression

$$\sigma = \left(\sum_{i}^{n_{DAT}} (z_{exptl} - z_{calcd})^2 / n_{DAT}\right)^{1/2} \tag{5}$$

where property values and the number of experimental data are represented by z and n_{DAT}, respectively.

Discussion

Figures 1−3 show the fitted curves, as well as excess changes on mixing and deviation values at 293.15 K, 298.15 K, 303.15 K, and 313.15 K for binary mixtures (diethyl carbonate + methanol, ethanol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, or 1-pentanol), and comparison is made with previous literature data.[5] Excess molar volumes are positive in the entire composition range except for the binary mixture (diethyl carbonate + methanol), where the excess values are negative. For changes of refractive index on mixing, the sign is negative for every binary mixture at every temperature except for (diethyl carbonate + methanol or ethanol), which show positive values. For

Table 3. Parameters and Root-Mean-Square Deviations σ^a

		Diethyl Carbonate (1) + Methanol (2)			
		293.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = -0.2722$	$B_1 = 0.1850$	$B_2 = -0.0379$		$\sigma_a = 0.002$
Δn_D	$B_0 = 0.0593$	$B_1 = -0.0313$	$B_2 = 0.0202$		$\sigma_b = 0.00005$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -312$	$B_1 = 213$	$B_2 = -182$		$\sigma_c = 0.7$
		298.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = -0.2707$	$B_1 = 0.1603$	$B_2 = -0.0062$		$\sigma_a = 0.001$
Δn_D	$B_0 = 0.0577$	$B_1 = -0.0323$	$B_2 = 0.0185$		$\sigma_b = 0.00008$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -329$	$B_1 = 215$	$B_2 = -158$		$\sigma_c = 0.7$
		303.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = -0.2219$	$B_1 = 0.2219$	$B_2 = -0.0633$		$\sigma_a = 0.002$
Δn_D	$B_0 = 0.0590$	$B_1 = -0.0288$	$B_2 = -0.0140$		$\sigma_b = 0.00006$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -341$	$B_1 = 232$	$B_2 = -142$		$\sigma_c = 0.5$
		313.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = -0.1290$	$B_1 = 0.1064$	$B_2 = 0.1498$		$\sigma_a = 0.002$
Δn_D	$B_0 = 0.0581$	$B_1 = -0.0320$	$B_2 = 0.0126$		$\sigma_b = 0.00005$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -361$	$B_1 = 282$	$B_2 = -240$		$\sigma_c = 0.6$
		Diethyl Carbonate (1) + Ethanol (2)			
		293.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.3341$	$B_1 = 0.3805$	$B_2 = 0.1886$		$\sigma_a = 0.004$
Δn_D	$B_0 = 0.0163$	$B_1 = -0.0054$	$B_2 = 0.0034$		$\sigma_b = 0.00005$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -168$	$B_1 = 100$	$B_2 = -66$		$\sigma_c = 0.4$
		298.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.4590$	$B_1 = 0.3177$			$\sigma_a = 0.005$
Δn_D	$B_0 = 0.0147$	$B_1 = -0.0071$			$\sigma_b = 0.00006$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -168$	$B_1 = 98$	$B_2 = -71$		$\sigma_c = 0.5$
		303.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.5068$	$B_1 = 0.2671$	$B_2 = -0.0469$		$\sigma_a = 0.002$
Δn_D	$B_0 = 0.0145$	$B_1 = -0.0075$	$B_2 = 0.0043$		$\sigma_b = 0.00005$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -168$	$B_1 = 95$	$B_2 = -75$		$\sigma_c = 0.5$
		313.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.6022$	$B_1 = 0.5751$	$B_2 = 0.3100$		$\sigma_a = 0.005$
Δn_D	$B_0 = 0.0128$	$B_1 = -0.0061$	$B_2 = 0.0016$		$\sigma_b = 0.00005$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -166$	$B_1 = 96$	$B_2 = -71$		$\sigma_c = 0.5$
		Diethyl Carbonate (1) + 1-Propanol (2)			
		293.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.7709$	$B_1 = 0.2144$	$B_2 = -0.2270$		$\sigma_a = 0.005$
Δn_D	$B_0 = -0.0030$	$B_1 = 0.0019$	$B_2 = 0.0020$		$\sigma_b = 0.00005$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -30$	$B_1 = 13$	$B_2 = -25$		$\sigma_c = 0.2$
		298.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.9430$	$B_1 = 0.2047$	$B_2 = 0.1177$		$\sigma_a = 0.003$
Δn_D	$B_0 = -0.0041$	$B_1 = 0.0014$	$B_2 = -0.0011$		$\sigma_b = 0.00004$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -17$	$B_1 = 5$	$B_2 = -20$		$\sigma_c = 0.2$
		303.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 0.9713$	$B_1 = 0.1278$	$B_2 = 0.1699$	$B_3 = 0.0099$	$\sigma_a = 0.003$
Δn_D	$B_0 = -0.0049$	$B_1 = -0.0007$	$B_2 = -0.0023$		$\sigma_b = 0.00002$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -21$	$B_1 = 2$	$B_2 = -18$		$\sigma_c = 0.3$
		313.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.2460$	$B_1 = 0.0104$	$B_2 = 0.4227$		$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0052$	$B_1 = 0.0016$	$B_2 = -0.0024$		$\sigma_b = 0.00004$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -11$	$B_1 = -9$	$B_2 = 22$		$\sigma_c = 0.6$
		Diethyl Carbonate (1) + 2-Propanol (2)			
		293.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.4157$	$B_1 = 0.1260$	$B_2 = 0.0847$		$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0007$	$B_1 = 0.0003$	$B_2 = -0.0001$		$\sigma_b = 0.00003$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -93$	$B_1 = 46$	$B_2 = -42$		$\sigma_c = 0.5$
		298.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.6139$	$B_1 = 0.2070$	$B_2 = 0.4504$		$\sigma_a = 0.003$
Δn_D	$B_0 = -0.0030$	$B_1 = 0.0002$	$B_2 = -0.0018$	$B_3 = 0.0012$	$\sigma_b = 0.00002$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -89$	$B_1 = 40$	$B_2 = -21$		$\sigma_c = 0.1$
		303.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.7161$	$B_1 = 0.1380$	$B_2 = 0.2909$		$\sigma_a = 0.005$
Δn_D	$B_0 = -0.0023$	$B_1 = -0.0010$	$B_2 = -0.0031$		$\sigma_b = 0.00004$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -85$	$B_1 = 29$	$B_2 = -21$		$\sigma_c = 0.2$
		313.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 2.0617$	$B_1 = 0.0725$	$B_2 = 0.5043$		$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0035$	$B_1 = 0.0003$	$B_2 = -0.0042$		$\sigma_b = 0.00003$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = -80$	$B_1 = 25$	$B_2 = -2$		$\sigma_c = 0.4$
		Diethyl Carbonate (1) + 1-Butanol (2)			
		293.15 K			
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.0400$	$B_1 = 0.0561$	$B_2 = -0.0150$		$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0081$	$B_1 = 0.0004$	$B_2 = 0.0039$		$\sigma_b = 0.00004$
$\Delta \kappa_S/(TPa^{-1})$	$B_0 = 28$	$B_1 = -10$	$B_2 = -17$		$\sigma_c = 0.3$

Table 3. (Continued)

		Diethyl Carbonate (1) + 1-Butanol (2)		
		298.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.1688$	$B_1 = -0.1012$	$B_2 = 0.4723$	$\sigma_a = 0.003$
Δn_D	$B_0 = -0.0079$	$B_1 = -0.00002$	$B_2 = 0.0013$	$\sigma_b = 0.00002$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 33$	$B_1 = -13$	$B_2 = -9$	$\sigma_c = 0.2$
		303.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.1755$	$B_1 = 0.0243$	$B_2 = 0.0691$	$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0092$	$B_1 = 0.0012$	$B_2 = -0.0028$	$\sigma_b = 0.00005$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 37$	$B_1 = -18$	$B_2 = -10$	$\sigma_c = 0.2$
		313.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.4790$	$B_1 = -0.0798$	$B_2 = 0.4347$	$\sigma_a = 0.005$
Δn_D	$B_0 = -0.0095$	$B_1 = 0.0009$	$B_2 = 0.0012$	$\sigma_b = 0.00004$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 48$	$B_1 = -50$	$B_2 = 34$	$\sigma_c = 0.4$
		Diethyl Carbonate (1) + 2-Butanol (2)		
		293.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 2.7830$	$B_1 = -0.2491$	$B_2 = 0.4705$	$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0134$	$B_1 = 0.0029$	$B_2 = -0.00005$	$\sigma_b = 0.00004$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 79$	$B_1 = -42$	$B_2 = 13$	$\sigma_c = 0.4$
		298.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 2.3752$	$B_1 = -0.1727$	$B_2 = 0.4677$	$\sigma_a = 0.002$
Δn_D	$B_0 = -0.0114$	$B_1 = 0.0021$	$B_2 = -0.0041$	$\sigma_b = 0.00003$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 52$	$B_1 = -26$	$B_2 = 3$	$\sigma_c = 0.3$
		303.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 2.4017$	$B_1 = -0.1456$	$B_2 = 0.1633$	$\sigma_a = 0.003$
Δn_D	$B_0 = -0.0117$	$B_1 = 0.0009$	$B_2 = -0.0004$	$\sigma_b = 0.00006$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 53$	$B_1 = -16$	$B_2 = -5$	$\sigma_c = 0.2$
		313.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 3.6671$	$B_1 = -0.7486$	$B_2 = 0.7014$	$\sigma_a = 0.004$
Δn_D	$B_0 = -0.01133$	$B_1 = 0.00111$	$B_2 = -0.00270$	$\sigma_b = 0.00004$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 149$	$B_1 = -49$	$B_2 = 15$	$\sigma_c = 0.5$
		Diethyl Carbonate (1) + 1-Pentanol (2)		
		293.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.1492$	$B_1 = 0.2103$	$B_2 = -0.0154$	$\sigma_a = 0.005$
Δn_D	$B_0 = -0.0079$	$B_1 = 0.0013$	$B_2 = 0.0012$	$\sigma_b = 0.00003$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 48$	$B_1 = -7$	$B_2 = -43$	$\sigma_c = 0.5$
		298.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.3385$	$B_1 = 0.1090$		$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0083$	$B_1 = 0.0009$	$B_2 = -0.0039$	$\sigma_b = 0.00004$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 57$	$B_1 = 7$	$B_2 = -32$	$\sigma_c = 0.2$
		303.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.4013$	$B_1 = -0.0585$	$B_2 = 0.1884$	$\sigma_a = 0.004$
Δn_D	$B_0 = -0.0083$	$B_1 = -0.00004$	$B_2 = -0.0003$	$\sigma_b = 0.00003$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 67$	$B_1 = -20$	$B_2 = -13$	$\sigma_c = 0.2$
		313.15 K		
$V^E/(cm^3 \cdot mol^{-1})$	$B_0 = 1.8664$	$B_1 = -0.1473$	$B_2 = 0.3057$	$\sigma_a = 0.006$
Δn_D	$B_0 = -0.0087$	$B_1 = 0.0008$	$B_2 = 0.0018$	$\sigma_b = 0.00004$
$\Delta\kappa_S/(TPa^{-1})$	$B_0 = 88$	$B_1 = -40$	$B_2 = 3$	$\sigma_c = 0.3$

[a] Units of root-mean-square deviations: $\sigma_a/(cm^3 \cdot mol^{-1})$; σ_b/(without units); $\sigma_c/(TPa^{-1})$.

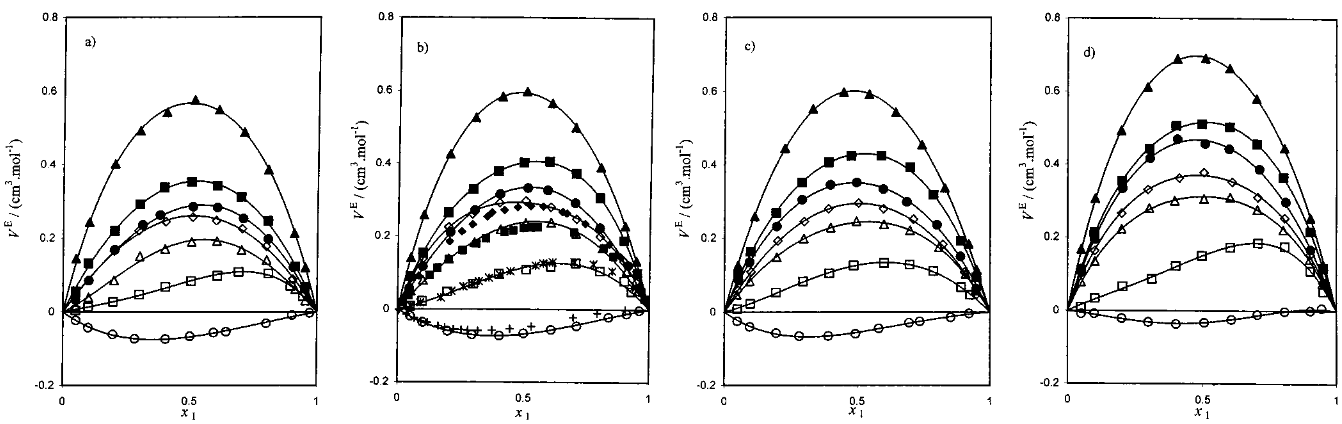

Figure 1. Curves of excess molar volumes for diethyl carbonate + methanol (○, this work; +, Francesconi and Comelli);[5] diethyl carbonate + ethanol (□, this work; ∗, Francesconi and Comelli);[5] diethyl carbonate + 1-propanol (△, this work; ■, Francesconi and Comelli);[5] diethyl carbonate + 2-propanol (■, this work); diethyl carbonate + 1-butanol (◇, this work; ◆, Francesconi and Comelli);[5] diethyl carbonate + 2-butanol (▲, this work); and diethyl carbonate + 1-pentanol (●, this work) at (a) 293.15 K, (b) 298.15 K, (c) 303.15 K, and (d) 313.15 K.

deviation in isentropic compressibility negative values are observed in the entire composition range for the binary mixtures diethyl carbonate + alcohol when the length of the chain of the alcohol is small; when this one is larger

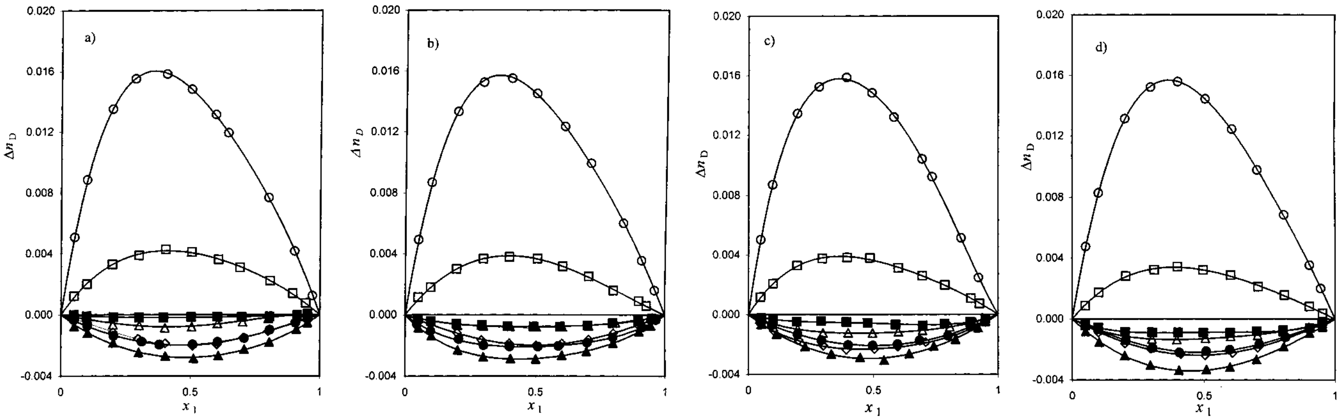

Figure 2. Curves of changes of refractive index on mixing for diethyl carbonate + methanol (○ this work); diethyl carbonate + ethanol (□, this work); diethyl carbonate + 1-propanol (△, this work); diethyl carbonate + 2-propanol (■, this work); diethyl carbonate + 1-butanol (◇, this work); diethyl carbonate + 2-butanol (▲, this work); and diethyl carbonate + 1-pentanol (●, this work) at (a) 293.15 K, (b) 298.15 K, (c) 303.15 K, and (d) 313.15 K.

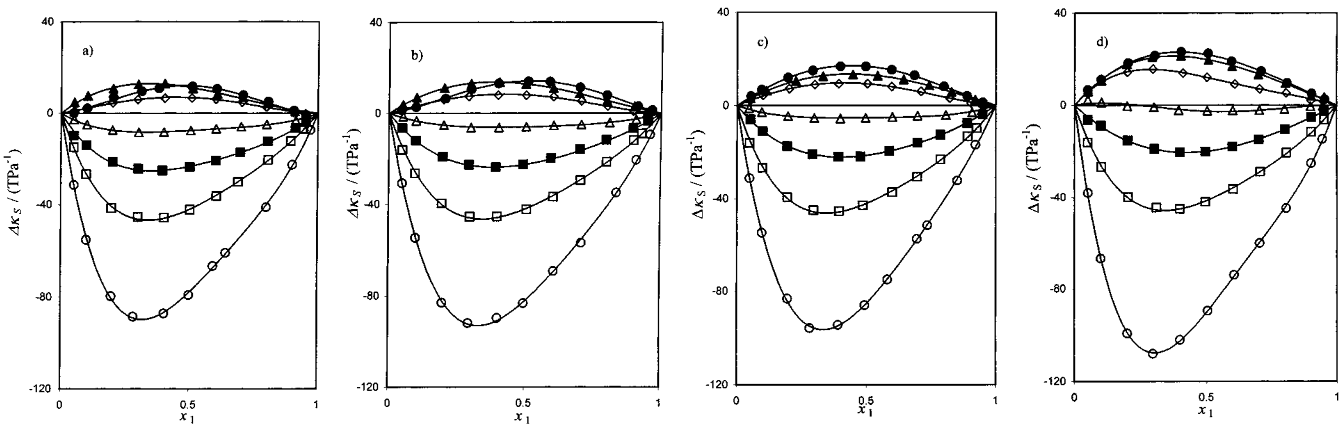

Figure 3. Curves of deviations in isentropic compressibility for diethyl carbonate + methanol (○ this work); diethyl carbonate + ethanol (□, this work); diethyl carbonate + 1-propanol (△, this work); diethyl carbonate + 2-propanol (■, this work); diethyl carbonate + 1-butanol (◇, this work); diethyl carbonate + 2-butanol (▲, this work); and diethyl carbonate + 1-pentanol (●, this work); at (a) 293.15 K, (b) 298.15 K, (c) 303.15 K, and (d) 313.15 K.

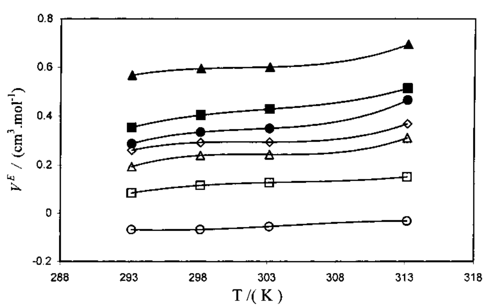

Figure 4. Curves of excess molar volumes for diethyl carbonate + methanol (○, this work); diethyl carbonate + ethanol (□, this work); diethyl carbonate + 1-propanol (△, this work); diethyl carbonate + 2-propanol (■, this work); diethyl carbonate + 1-butanol (◇, this work); diethyl carbonate + 2-butanol (▲, this work); and diethyl carbonate + 1-pentanol (●, this work) versus temperature from 293.15 K to 313.15 K when the composition is equimolar.

(1-butanol, 2-butanol, or 1-pentanol), positive values are observed. Figure 4 shows the variation of the excess molar volume with the temperature at $x = 0.5$.

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