Supporting Information

Density, Viscosity, Refractive Index and Freezing Point for Binary Mixtures of 1,1'-Bicyclohexyl with Alkylcyclohexane

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Table S1. Excess Molar Volumes (V_m^E) for the Binary Systems of 1,1'-Bicyclohexyl (1) + Alkylcyclohexane(2) with Different Mole Fraction(x_1) at Temperature T = (293.15 to 323.15) K and Pressure p = 0.1 MPa[a]

	V_m^E / cm^3·mol^{-1}					
x_1	293.15 K	298.15 K	303.15 K	308.15 K	313.15 K	318.15 K
1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)						
0.0000	0.000	0.000	0.000	0.000	0.000	0.000
0.0999	-0.116	-0.135	-0.146	-0.157	-0.167	-0.178
0.2015	-0.211	-0.223	-0.239	-0.256	-0.274	-0.292
0.3012	-0.266	-0.289	-0.310	-0.331	-0.352	-0.375
0.4007	-0.269	-0.295	-0.317	-0.339	-0.362	-0.385
0.4994	-0.256	-0.276	-0.306	-0.320	-0.340	-0.366
0.5986	-0.227	-0.249	-0.276	-0.287	-0.308	-0.329
0.7002	-0.198	-0.221	-0.237	-0.233	-0.266	-0.287
0.7998	-0.132	-0.151	-0.163	-0.175	-0.187	-0.200
0.8998	-0.070	-0.077	-0.083	-0.089	-0.096	-0.103
1.0000	0.000	0.000	0.000	0.000	0.000	0.000
1,1'-Bicyclohexyl (1) + Ethylcyclohexane (2)						
0.0000	0.000	0.000	0.000	0.000	0.000	0.000
0.1001	-0.066	-0.071	-0.076	-0.081	-0.086	-0.092
0.2003	-0.111	-0.121	-0.129	-0.138	-0.147	-0.156
0.3001	-0.140	-0.151	-0.161	-0.171	-0.183	-0.194
0.4002	-0.166	-0.180	-0.190	-0.202	-0.215	-0.228
0.4980	-0.163	-0.176	-0.186	-0.197	-0.211	-0.225
0.5996	-0.151	-0.163	-0.178	-0.183	-0.197	-0.209
0.6996	-0.133	-0.141	-0.150	-0.160	-0.171	-0.182
0.7983	-0.085	-0.092	-0.098	-0.105	-0.113	-0.120
0.9010	-0.044	-0.048	-0.051	-0.055	-0.059	-0.063
1.0000	0.000	0.000	0.000	0.000	0.000	0.000
1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)						
0.0000	0.000	0.000	0.000	0.000	0.000	0.000
0.1002	-0.059	-0.062	-0.065	-0.067	-0.070	-0.072
0.2003	-0.094	-0.098	-0.102	-0.106	-0.111	-0.115
0.2997	-0.119	-0.125	-0.130	-0.135	-0.141	-0.147
0.4002	-0.143	-0.141	-0.147	-0.153	-0.159	-0.166
0.4999	-0.142	-0.148	-0.154	-0.160	-0.166	-0.173
0.6011	-0.130	-0.135	-0.140	-0.146	-0.153	-0.158
0.7003	-0.119	-0.125	-0.130	-0.134	-0.140	-0.145
0.7999	-0.084	-0.089	-0.092	-0.095	-0.100	-0.104
0.9008	-0.053	-0.055	-0.056	-0.058	-0.060	-0.063
1.0000	0.000	0.000	0.000	0.000	0.000	0.000

[a] x_1 is the mole fraction of 1,1'-bicyclohexyl in the binary systems. Standard uncertainties u are u (x) = 0.0001, u (T) = 0.01 K. The combined expanded uncertainty

is u_c (V_m^E) = 0.001 $cm^3 \cdot mol^{-1}$ (level of confidence = 0.95).

Table S2. Parameters and Standard Deviations (σ) for V_m^E Correlation with the Redlich-Kister Equation of the Binary Systems at Different Temperatures (T)

T / K	A_0	A_1	A_2	A_3	σ
1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)					
293.15	-1.059	0.465	0.015	-0.224	0.007
298.15	-1.149	0.394	-0.057	0.003	0.008
303.15	-1.249	0.399	-0.039	0.057	0.006
308.15	-1.303	0.517	-0.104	-0.087	0.006
313.15	-1.403	0.484	-0.106	0.003	0.008
318.15	-1.501	0.496	-0.107	0.030	0.008
1,1'-Bicyclohexyl (1) + Ethylcyclohexane (2)					
293.15	-0.657	0.073	0.083	0.126	0.004
298.15	-0.706	0.096	0.082	0.097	0.004
303.15	-0.754	0.093	0.084	0.120	0.004
308.15	-0.795	0.110	0.073	0.108	0.004
313.15	-0.850	0.111	0.073	0.121	0.004
318.15	-0.903	0.114	0.072	0.138	0.004
1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)					
293.15	-0.557	0.043	-0.074	-0.008	0.004
298.15	-0.572	0.018	-0.105	0.047	0.003
303.15	-0.596	0.022	-0.100	0.054	0.003
308.15	-0.200	0.022	-0.096	0.065	0.003
313.15	-0.648	0.025	-0.097	0.057	0.003
318.15	-0.672	0.027	-0.101	0.027	0.004

Table S3. Viscosity Deviations ($\Delta\eta$) for the Binary Systems of 1,1'-Bicyclohexyl (1) + Alkylcyclohexane(2) at Different Temperatures (T)[a]

	$\Delta\eta$ / mPa·s					
x_1	293.15 K	298.15 K	303.15 K	308.15 K	313.15 K	318.15 K
1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)						
0.0000	0.000	0.000	0.000	0.000	0.000	0.000
0.0999	-0.179	-0.151	-0.127	-0.108	-0.092	-0.080
0.2015	-0.342	-0.285	-0.244	-0.204	-0.176	-0.152
0.3012	-0.453	-0.373	-0.312	-0.264	-0.225	-0.192
0.4007	-0.536	-0.441	-0.367	-0.308	-0.261	-0.224
0.4994	-0.603	-0.496	-0.404	-0.339	-0.288	-0.245
0.5986	-0.579	-0.472	-0.387	-0.322	-0.277	-0.227
0.7002	-0.525	-0.424	-0.340	-0.285	-0.243	-0.193
0.7998	-0.424	-0.342	-0.277	-0.232	-0.193	-0.163
0.8998	-0.260	-0.205	-0.165	-0.137	-0.116	-0.094
1.0000	0.000	0.000	0.000	0.000	0.000	0.000
1,1'-Bicyclohexyl (1) + Ethylcyclohexane(2)						
0.0000	0.000	0.000	0.000	0.000	0.000	0.000
0.1001	-0.171	-0.137	-0.114	-0.096	-0.082	-0.070
0.2003	-0.320	-0.267	-0.223	-0.189	-0.162	-0.139
0.3001	-0.431	-0.356	-0.294	-0.247	-0.210	-0.180
0.4002	-0.497	-0.406	-0.335	-0.292	-0.240	-0.205
0.4980	-0.579	-0.478	-0.395	-0.328	-0.279	-0.237
0.5996	-0.610	-0.502	-0.415	-0.345	-0.298	-0.251
0.6996	-0.615	-0.506	-0.419	-0.354	-0.301	-0.257
0.7983	-0.505	-0.413	-0.339	-0.285	-0.242	-0.206
0.9010	-0.325	-0.266	-0.218	-0.183	-0.157	-0.134
1.0000	0.000	0.000	0.000	0.000	0.000	0.000
1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)						
0.0000	0.000	0.000	0.000	0.000	0.000	0.000
0.1002	-0.143	-0.122	-0.103	-0.089	-0.077	-0.067
0.2003	-0.259	-0.218	-0.184	-0.159	-0.137	-0.120
0.2997	-0.358	-0.301	-0.253	-0.217	-0.186	-0.162
0.4002	-0.435	-0.364	-0.304	-0.260	-0.225	-0.194
0.4999	-0.474	-0.394	-0.330	-0.281	-0.242	-0.209
0.6011	-0.483	-0.401	-0.334	-0.283	-0.244	-0.210
0.7003	-0.444	-0.368	-0.303	-0.259	-0.222	-0.192
0.7999	-0.342	-0.275	-0.230	-0.187	-0.162	-0.138
0.9008	-0.184	-0.158	-0.130	-0.109	-0.095	-0.081
1.0000	0.000	0.000	0.000	0.000	0.000	0.000

[a] x_1 is the mole fraction of 1,1'-bicyclohexyl in the binary systems. Standard uncertainties u are u (x) = 0.0001, u (T) = 0.01 K. The combined expanded uncertainty is u_c ($\Delta\eta$) = 0.005 mPa·s (level of confidence = 0.95).

Table S4. Parameters and Standard Deviations (σ) for Viscosity Deviations Correlation with the Redlich-Kister Equation of the Binary Systems at Different Temperatures (T)

T / K	A_0	A_1	A_2	A_3	σ
1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)					
293.15	-2.333	-0.372	-0.149	-0.276	0.009
298.15	-1.913	-0.268	-0.088	-0.147	0.008
303.15	-1.571	-0.132	-0.079	-0.191	0.006
308.15	-1.317	-0.103	-0.064	-0.148	0.005
313.15	-1.122	-0.083	-0.051	-0.106	0.005
318.15	-0.942	0.000	-0.039	-0.150	0.006
1,1'-Bicyclohexyl (1) + Ethylcyclohexane (2)					
293.15	-2.319	-1.012	-0.717	-0.082	0.011
298.15	-1.914	-0.807	-0.545	-0.120	0.011
303.15	-1.583	-0.663	-0.443	-0.075	0.010
308.15	-1.334	-0.528	-0.367	-0.113	0.008
313.15	-1.129	-0.470	-0.335	-0.059	0.008
318.15	-0.960	-0.385	-0.296	-0.080	0.007
1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)					
293.15	-1.919	-0.575	0.141	0.424	0.003
298.15	-1.588	-0.406	0.058	0.233	0.004
303.15	-1.327	-0.316	0.052	0.191	0.002
308.15	-1.129	-0.235	0.052	0.152	0.004
313.15	-0.971	-0.197	0.032	0.109	0.003
318.15	-0.838	-0.162	0.035	0.109	0.003

Table S5. Refractive Indices (n_D) for the Binary Systems of 1,1'-Bicyclohexyl (1) + Alkylcyclohexane(2) with Different Mole Fraction (x_1) at Temperature T = (293.15, 303.15, 313.15) K and Pressure p = 0.1MPa[a]

	n_D		
x_1	293.15 K	303.15 K	313.15 K
1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)			
0.0000	1.4226	1.4175	1.4123
0.0999	1.4316	1.4263	1.4214
0.2015	1.4396	1.4344	1.4295
0.3012	1.4463	1.4421	1.4372
0.4007	1.4520	1.4477	1.4432
0.4994	1.4587	1.4545	1.4501
0.5986	1.4626	1.4584	1.4533
0.7002	1.4670	1.4626	1.4588
0.7999	1.4715	1.4671	1.4627
0.8998	1.4752	1.4711	1.4669
1.0000	1.4787	1.4743	1.4702
1,1'-Bicyclohexyl (1) + Ethylcyclohexane (2)			
0.0000	1.4327	1.4275	1.4227
0.1001	1.4387	1.4340	1.4290
0.2003	1.4447	1.4399	1.4354
0.3001	1.4498	1.4454	1.4407
0.4002	1.4547	1.4503	1.4458
0.4980	1.4595	1.4549	1.4505
0.5996	1.4635	1.4598	1.4548
0.6996	1.4677	1.4636	1.4593
0.7983	1.4715	1.4672	1.4628
0.9010	1.4752	1.4711	1.4667
1.0000	1.4787	1.4744	1.4702
1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)			
0.0000	1.4399	1.4356	1.4311
0.1002	1.4442	1.4401	1.4354
0.2003	1.4483	1.4441	1.4395
0.2997	1.4525	1.4483	1.4436
0.4002	1.4564	1.4522	1.4477
0.4999	1.4604	1.4560	1.4518
0.6011	1.4642	1.4599	1.4555
0.7003	1.4681	1.4637	1.4593
0.7999	1.4716	1.4673	1.4629
0.9008	1.4751	1.4708	1.4666
1.0000	1.4787	1.4744	1.4702

[a] x_1 is the mole fraction of 1,1'-bicyclohexyl in the binary systems. Standard uncertainties u are u (x) = 0.0001, u (T) = 0.01 K and u (n_D) = 0.002.

Table S6. Refractive Index Deviations (Δn_D) for the Binary Systems of 1,1'-Bicyclohexyl (1) + Alkylcyclohexane(2) with Different Mole Fraction (x_1) at Temperature T = (293.15, 303.15, 313.15) K and Pressure p = 0.1MPa[a]

	Δn_D		
x_1	293.15 K	303.15 K	313.15 K
	1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)		
0.0000	0.0000	0.0000	0.0000
0.0999	0.0034	0.0032	0.0033
0.2015	0.0056	0.0055	0.0055
0.3012	0.0068	0.0075	0.0075
0.4007	0.0069	0.0074	0.0077
0.4994	0.0081	0.0086	0.0089
0.5986	0.0064	0.0069	0.0064
0.7002	0.0051	0.0053	0.0060
0.7998	0.0040	0.0042	0.0041
0.8998	0.0021	0.0025	0.0025
1.0000	0.0000	0.0000	0.0000
	1,1'-Bicyclohexyl (1) + Ethylcyclohexane (2)		
0.0000	0.0000	0.0000	0.0000
0.1001	0.0013	0.0018	0.0015
0.2003	0.0027	0.0030	0.0032
0.3001	0.0032	0.0038	0.0036
0.4002	0.0036	0.0041	0.0041
0.4980	0.0038	0.0041	0.0040
0.5996	0.0032	0.0042	0.0035
0.6996	0.0028	0.0033	0.0033
0.7983	0.0021	0.0023	0.0022
0.9010	0.0010	0.0014	0.0013
1.0000	0.0000	0.0000	0.0000
	1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)		
0.0000	0.0000	0.0000	0.0000
0.1002	0.0004	0.0007	0.0004
0.2003	0.0007	0.0008	0.0006
0.2997	0.0009	0.0011	0.0008
0.4002	0.0010	0.0011	0.0010
0.4999	0.0011	0.0010	0.0012
0.6011	0.0010	0.0010	0.0009
0.7003	0.0010	0.0009	0.0008
0.7999	0.0006	0.0007	0.0005
0.9008	0.0002	0.0003	0.0003
1.0000	0.0000	0.0000	0.0000

[a]x_1 is the mole fraction of 1,1'-bicyclohexyl in the binary systems. Standard uncertainties u are u (x) = 0.0001, u (T) = 0.01 K. The combined expanded uncertainty is u (Δn_D) = 0.0008 (level of confidence = 0.95).

Table S7. Parameters and Standard Deviations (σ) for Refractive Index Deviations Correlation with the Redlich-Kister Equation of the Binary Systems at Temperature T = (293.15, 303.15, 313.15) K

T / K	A_0	A_1	A_2	A_3	σ
1,1'-Bicyclohexyl (1) + Methylcyclohexane (2)					
293.15	0.0289	-0.0086	0.0026	0.0002	0.0004
303.15	0.0309	-0.0116	0.0000	0.0110	0.0004
313.15	0.0314	-0.0105	0.0001	0.0076	0.0005
1,1'-Bicyclohexyl (1) + Ethylcyclohexane (2)					
293.15	0.0149	-0.0034	-0.0021	0.0018	0.0001
303.15	0.0167	-0.0028	0.0013	-0.0006	0.0001
313.15	0.0162	-0.0054	-0.0003	0.0057	0.0002
1,1'-Bicyclohexyl (1) + Butylcyclohexane (2)					
293.15	0.0045	0.0010	-0.0013	-0.0040	0.0001
303.15	0.0043	0.0002	0.0017	-0.0042	0.0001
313.15	0.0041	-0.0001	-0.0002	-0.0013	0.0001