Novel binary mixtures of alkanolamine based deep eutectic solvents with water - thermodynamic calculation and correlation of crucial physicochemical properties

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Table S1. Densities ρ, excess molar volumes V^E, isobaric thermal expansion coefficients α_p , excess thermal expansion $\Delta\alpha_p$, speeds of sound u, excess isentropic compressibilities k_S^E, viscosities η, viscosity deviations $\Delta\eta$, excess Gibbs free energy of activation of viscous flow ΔG^{*E}, refractive indices n_D, refractive index deviations Δn_D as functions of mole fraction, x_1 of DES for TBAB:AP (DES1) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure. [a]

x_1	ρ / kg·m^{-3}	$10^6\ V_m^E$/ m^3·mol^{-1}	$10^4\ \alpha_p$ / K^{-1}	$10^4\ \Delta\alpha_p$ / K^{-1}	u / m·s^{-1}	$10^{10}\ k_S^E$ / Pa^{-1}	η / mPa·s	$\Delta\eta$ / mPa·s	ΔG^{*E} / J·mol^{-1}	n_D	Δn_D
293.15 K											
0.0000	998.20	0.000	2.119	0.000	1482.52	0.000	1.05	0.000	0.00	1.3340	0.00000
0.0994	1022.32	-0.453	5.944	1.742	1767.38	-1.185	6.47	4.843	3874.91	1.3950	0.00413
0.1981	1032.09	-0.817	7.296	2.057	1811.29	-1.185	18.21	15.695	5585.67	1.4266	0.00742
0.2979	1033.23	-0.979	7.437	1.569	1796.62	-1.002	33.67	29.766	6123.90	1.4440	0.00764
0.3961	1031.40	-1.006	7.477	1.196	1772.86	-0.810	49.46	43.439	6022.89	1.4550	0.00736
0.4983	1028.66	-0.950	7.390	0.802	1748.67	-0.627	60.74	51.292	5373.26	1.4620	0.00599
0.5987	1025.68	-0.827	7.393	0.581	1727.08	-0.467	75.12	60.412	4709.86	1.4667	0.00456
0.6999	1022.93	-0.668	7.356	0.368	1707.97	-0.325	85.40	62.416	3790.44	1.4702	0.00326
0.8000	1020.02	-0.445	7.325	0.198	1688.58	-0.187	93.99	58.259	2775.90	1.4726	0.00187
0.9000	1017.55	-0.211	7.473	0.233	1675.64	-0.083	96.45	40.920	1565.90	1.4750	0.00118
1.0000	1015.71	0.000	7.334	0.000	1666.29	0.000	86.30	0.000	0.00	1.4764	0.00000
298.15 K											
0.0000	997.05	0.000	2.565	0.000	1496.8	0.000	0.90	0.000	0.00	1.3331	0.00000
0.0994	1019.24	-0.432	6.110	1.634	1757.08	-1.113	5.25	3.879	3852.17	1.3937	0.00400
0.1981	1028.31	-0.784	7.376	1.950	1796.54	-1.131	13.92	11.837	5487.88	1.4250	0.00717
0.2979	1029.38	-0.947	7.517	1.515	1781.00	-0.965	25.20	22.023	6025.66	1.4423	0.00742
0.3961	1027.54	-0.978	7.530	1.150	1756.80	-0.783	35.95	31.134	5892.31	1.4532	0.00712
0.4983	1024.84	-0.928	7.451	0.791	1732.43	-0.609	44.31	36.886	5284.13	1.4601	0.00572
0.5987	1021.89	-0.809	7.432	0.567	1710.67	-0.454	54.10	42.745	4620.34	1.4649	0.00443
0.6999	1019.16	-0.655	7.397	0.371	1691.51	-0.317	61.29	43.856	3719.78	1.4684	0.00318
0.8000	1016.25	-0.434	7.331	0.178	1671.67	-0.181	67.26	40.626	2723.50	1.4708	0.00182
0.9000	1013.78	-0.203	7.457	0.200	1657.12	-0.072	69.02	28.345	1535.51	1.4731	0.00106
1.0000	1011.99	0.000	7.343	0.000	1649.50	0.000	62.12	0.000	0.00	1.4746	0.00000
303.15 K											
0.0000	995.65	0.000	3.010	0.000	1509.53	0.000	0.79	0.000	0.00	1.3322	0.00000
0.0994	1016.09	-0.412	6.275	1.526	1746.66	-1.049	4.39	3.204	3835.67	1.3925	0.00394

0.1981	1024.50	-0.752	7.456	1.844	1781.64	-1.082	11.06	9.285	5408.30	1.4234	0.00687
0.2979	1025.50	-0.918	7.597	1.463	1765.20	-0.931	19.47	16.803	5921.86	1.4407	0.00723
0.3961	1023.66	-0.951	7.583	1.105	1740.68	-0.760	27.16	23.176	5766.31	1.4514	0.00680
0.4983	1021.02	-0.906	7.513	0.781	1715.83	-0.591	33.07	27.023	5155.10	1.4583	0.00546
0.5987	1018.09	-0.792	7.471	0.553	1694.24	-0.443	40.39	31.278	4518.31	1.4632	0.00433
0.6999	1015.39	-0.642	7.438	0.374	1674.98	-0.309	45.65	31.870	3634.30	1.4667	0.00310
0.8000	1012.58	-0.433	7.336	0.157	1656.35	-0.182	49.32	28.582	2618.91	1.4691	0.00178
0.9000	1009.99	-0.193	7.441	0.168	1639.39	-0.065	50.84	19.640	1459.93	1.4714	0.00104
1.0000	1008.28	0.000	7.351	0.000	1632.76	0.000	46.94	0.000	0.00	1.4729	0.00000
308.15 K											
0.0000	994.03	0.000	3.455	0.000	1520.29	0.000	0.69	0.000	0.00	1.3314	0.00000
0.0994	1012.87	-0.393	6.441	1.420	1736.11	-0.992	3.72	2.698	3859.25	1.3913	0.00388
0.1981	1020.68	-0.723	7.536	1.738	1766.28	-1.038	8.96	7.451	5377.72	1.4217	0.00650
0.2979	1021.59	-0.888	7.677	1.410	1749.37	-0.901	15.33	13.092	5860.90	1.4389	0.00689
0.3961	1019.77	-0.925	7.636	1.060	1724.41	-0.739	21.05	17.752	5695.79	1.4495	0.00646
0.4983	1017.18	-0.885	7.575	0.771	1699.51	-0.578	25.34	20.402	5080.02	1.4565	0.00528
0.5987	1014.28	-0.775	7.511	0.540	1677.87	-0.434	30.69	23.349	4445.32	1.4614	0.00420
0.6999	1011.61	-0.629	7.479	0.378	1658.56	-0.304	34.65	23.700	3578.47	1.4649	0.00302
0.8000	1008.85	-0.426	7.342	0.137	1638.97	-0.175	38.32	22.062	2640.15	1.4672	0.00163
0.9000	1006.24	-0.185	7.425	0.136	1622.30	-0.061	39.70	15.568	1509.07	1.4695	0.00091
1.0000	1004.58	0.000	7.359	0.000	1615.89	0.000	35.82	0.000	0.00	1.4711	0.00000
313.15 K											
0.0000	992.22	0.000	3.901	0.000	1529.42	0.000	0.61	0.000	0.00	1.3305	0.00000
0.0994	1009.57	-0.375	6.607	1.314	1725.05	-0.940	3.16	2.268	3853.31	1.3900	0.00386
0.1981	1016.81	-0.695	7.616	1.634	1751.15	-0.998	7.44	6.138	5370.01	1.4199	0.00620
0.2979	1017.65	-0.86	7.757	1.359	1733.12	-0.873	12.36	10.454	5816.30	1.4370	0.00663
0.3961	1015.87	-0.900	7.688	1.016	1708.21	-0.719	16.53	13.754	5611.03	1.4475	0.00619
0.4983	1013.31	-0.864	7.636	0.761	1683.20	-0.564	19.63	15.526	4982.33	1.4545	0.00510
0.5987	1010.47	-0.758	7.550	0.526	1661.22	-0.424	23.86	17.835	4378.55	1.4595	0.00417
0.6999	1007.82	-0.616	7.520	0.381	1642.16	-0.298	26.82	17.945	3518.32	1.4629	0.00293
0.8000	1005.15	-0.421	7.347	0.116	1621.35	-0.166	29.92	16.906	2619.11	1.4652	0.00157
0.9000	1002.53	-0.181	7.409	0.104	1605.15	-0.055	31.17	12.091	1516.01	1.4675	0.00089
1.0000	1000.89	0.000	7.368	0.000	1599.37	0.000	27.97	0.000	0.00	1.4691	0.00000

[a] Standard uncertainties u are: $u(T)$ =0.01 K for density, speed of sound and viscosity and $u(T)$ = 0.1 K for refractive index, $u(p)$ = 10 kPa, $u(x_1)$ = $1 \cdot 10^{-4}$ $u(\rho)$ = 0.035 kg·m^{-3}, $u(u)$ = 0.2 m·s^{-1}, $u_r(\eta)$ = 1% , $u(n_D)$ = 0.0002

Table S2. Densities ρ, excess molar volumes V^E, isobaric thermal expansion coefficients α_p , excess thermal expansion $\Delta\alpha_p$, speeds of sound u, excess isentropic compressibilities k_S^E, viscosities η, viscosity deviations $\Delta\eta$, excess Gibbs free energy of activation of viscous flow ΔG^{*E}, refractive indices n_D, refractive index deviations Δn_D as functions of mole fraction, x_1 of DES for TBAC:AP (DES2) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure. [a]

x_1	ρ / kg·m^{-3}	$10^6\ V_m^E$ / m^3·mol^{-1}	$10^4\ \alpha_p$ / K^{-1}	$10^4\ \Delta\alpha_p$ / K^{-1}	u / m·s^{-1}	$10^{10}\ k_S^E$ / Pa^{-1}	η / mPa·s	$\Delta\eta$ / mPa·s	ΔG^{*E} / J·mol^{-1}	n_D	Δn_D
293.15 K											
0.0000	998.20	0.000	2.134	0.000	1482.52	0.000	1.05	0.000	0.00	1.3340	0.00000
0.0982	1004.94	-0.488	6.083	1.915	1788.22	-1.229	6.29	4.683	3813.83	1.3935	0.00580
0.1964	1004.60	-0.843	7.265	2.062	1843.38	-1.243	17.39	14.929	5494.35	1.4225	0.00759
0.2947	999.85	-1.002	7.469	1.642	1831.12	-1.056	30.98	27.194	5968.10	1.4392	0.00784
0.3943	994.14	-1.032	7.437	1.188	1808.34	-0.856	44.48	38.604	5810.89	1.4494	0.00690
0.4899	988.81	-0.974	7.407	0.866	1785.23	-0.674	56.32	47.277	5324.20	1.4563	0.00612
0.5921	983.76	-0.855	7.360	0.586	1763.55	-0.504	65.59	51.626	4507.89	1.4613	0.00496
0.6905	979.41	-0.692	7.359	0.411	1744.52	-0.356	71.07	48.982	3522.16	1.4651	0.00416
0.7946	975.37	-0.483	7.351	0.255	1727.25	-0.220	77.89	44.519	2461.07	1.4679	0.00308
0.8959	971.90	-0.250	7.307	0.095	1713.19	-0.105	85.81	33.748	1421.25	1.4698	0.00191
1.0000	968.86	0.000	7.305	0.000	1700.32	0.000	82.77	0.000	0.00	1.4705	0.00000
298.15 K											
0.0000	997.04	0.000	2.575	0.000	1496.80	0.000	0.90	0.000	0.00	1.3331	0.00000
0.0982	1001.83	-0.464	6.192	1.750	1778.69	-1.161	5.06	3.705	3767.13	1.3921	0.00550
0.1964	1000.91	-0.809	7.344	1.953	1827.99	-1.188	13.34	11.299	5400.17	1.4210	0.00733
0.2947	996.10	-0.970	7.544	1.581	1814.97	-1.019	23.10	20.014	5853.61	1.4376	0.00757
0.3943	990.43	-1.005	7.508	1.158	1791.82	-0.829	32.34	27.631	5672.78	1.4478	0.00670
0.4899	985.13	-0.951	7.468	0.852	1768.62	-0.656	40.43	33.305	5186.02	1.4545	0.00577
0.5921	980.13	-0.838	7.410	0.580	1742.83	-0.476	47.04	36.223	4395.99	1.4594	0.00455
0.6905	975.80	-0.678	7.396	0.406	1727.69	-0.349	51.46	34.653	3457.91	1.4631	0.00369
0.7946	971.78	-0.473	7.371	0.248	1710.02	-0.215	56.44	31.454	2424.21	1.4661	0.00284
0.8959	968.35	-0.247	7.327	0.097	1695.62	-0.102	62.41	24.102	1418.02	1.4680	0.00169
1.0000	965.32	0.000	7.315	0.000	1682.88	0.000	59.81	0.000	0.00	1.4689	0.00000
303.15 K											
0.0000	995.65	0.000	3.016	0.000	1509.53	0.000	0.79	0.000	0.00	1.3322	0.00000
0.0982	998.74	-0.444	6.301	1.585	1768.06	-1.095	4.20	3.029	3732.44	1.3907	0.00528
0.1964	997.19	-0.777	7.422	1.844	1812.73	-1.138	10.64	8.903	5333.74	1.4194	0.00709

0.2947	992.34	-0.939	7.618	1.520	1798.92	-0.984	17.89	15.305	5758.47	1.4357	0.00715
0.3943	986.70	-0.978	7.578	1.129	1775.40	-0.805	24.43	20.548	5550.79	1.4460	0.00647
0.4899	981.45	-0.928	7.529	0.838	1751.99	-0.638	30.08	24.297	5055.75	1.4527	0.00560
0.5921	976.49	-0.820	7.460	0.575	1726.03	-0.463	35.17	26.529	4305.18	1.4576	0.00443
0.6905	972.20	-0.664	7.432	0.402	1710.85	-0.341	38.66	25.456	3402.54	1.4612	0.00351
0.7946	968.20	-0.463	7.392	0.241	1693.30	-0.211	42.88	23.544	2420.68	1.4640	0.00249
0.8959	964.81	-0.242	7.348	0.100	1678.51	-0.099	47.33	18.160	1433.04	1.4658	0.00127
1.0000	961.80	0.000	7.325	0.000	1665.99	0.000	44.78	0.000	0.00	1.4671	0.00000
308.15 K											
0.0000	994.03	0.000	3.457	0.000	1520.29	0.000	0.69	0.000	0.00	1.3314	0.00000
0.0982	995.58	-0.425	6.410	1.421	1757.38	-1.039	3.67	2.661	3828.70	1.3897	0.00505
0.1964	993.45	-0.747	7.500	1.735	1797.30	-1.094	8.70	7.222	5322.88	1.4184	0.00688
0.2947	988.55	-0.909	7.693	1.460	1782.62	-0.953	14.2	12.029	5713.07	1.4347	0.00696
0.3943	982.95	-0.951	7.648	1.100	1758.52	-0.782	18.92	15.703	5472.45	1.4448	0.00610
0.4899	977.75	-0.906	7.590	0.824	1735.23	-0.623	23.22	18.491	4993.20	1.4515	0.00525
0.5921	972.85	-0.802	7.510	0.570	1708.88	-0.451	27.45	20.476	4292.79	1.4563	0.00399
0.6905	968.58	-0.650	7.468	0.398	1693.99	-0.334	30.54	20.032	3439.23	1.4599	0.00308
0.7946	964.63	-0.454	7.413	0.234	1676.43	-0.207	33.23	18.034	2427.03	1.4627	0.00207
0.8959	961.26	-0.238	7.368	0.102	1661.65	-0.098	35.89	13.275	1401.48	1.4646	0.00096
1.0000	958.28	0.000	7.336	0.000	1648.89	0.000	34.23	0.000	0.00	1.4662	0.00000
313.15 K											
0.0000	992.21	0.000	3.898	0.000	1529.42	0.000	0.61	0.000	0.00	1.3305	0.00000
0.0982	992.34	-0.408	6.519	1.258	1746.33	-0.987	3.14	2.259	3841.10	1.3882	0.00483
0.1964	989.68	-0.718	7.578	1.627	1781.41	-1.052	7.43	6.156	5388.88	1.4167	0.00667
0.2947	984.73	-0.880	7.767	1.401	1766.25	-0.925	11.33	9.482	5642.12	1.4328	0.00670
0.3943	979.18	-0.926	7.718	1.071	1741.86	-0.762	15.00	12.297	5412.64	1.4428	0.00584
0.4899	974.03	-0.883	7.651	0.811	1718.48	-0.609	17.74	13.816	4860.83	1.4495	0.00506
0.5921	969.19	-0.785	7.560	0.566	1692.08	-0.441	21.26	15.547	4218.20	1.4543	0.00386
0.6905	964.96	-0.637	7.504	0.394	1676.87	-0.327	24.19	15.697	3441.56	1.4577	0.00279
0.7946	961.05	-0.445	7.434	0.227	1659.64	-0.204	26.42	14.286	2456.99	1.4604	0.00172
0.8959	957.72	-0.233	7.389	0.104	1644.80	-0.096	28.01	10.187	1399.79	1.4623	0.00064
1.0000	954.77	0.000	7.346	0.000	1631.99	0.000	26.61	0.000	0.00	1.4642	0.00000

[a] Standard uncertainties u are: $u(T)$ =0.01 K for density, speed of sound and viscosity and $u(T)$ = 0.1 K for refractive index, $u(p)$ = 10 kPa, $u(x_1) = 1 \cdot 10^{-4}$, $u(\rho)$ = 0.035 kg·m^{-3}, $u(u)$ = 0.2 m·s^{-1}, $u_r(\eta)$ = 1% , $u(n_D)$ = 0.0002

Table S3. Densities ρ, excess molar volumes V^E, isobaric thermal expansion coefficients α_p , excess thermal expansion $\Delta\alpha_p$, speed of sounds u, excess isentropic compressibilities k_S^E, viscosities η, viscosity deviations $\Delta\eta$, excess Gibbs free energy of activation of viscous flow ΔG^{*E}, refractive indices n_D, refractive index deviations Δn_D as functions of mole fraction, x_1 of DES for TBAB:MAE (DES3) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure. [a]

x_1	ρ / kg·m^{-3}	$10^6\ V_m^E$ / m^3·mol^{-1}	$10^4\ \alpha_p$ / K^{-1}	$10^4\Delta\alpha_p$ / K^{-1}	u / m·s^{-1}	$10^{10}\ k_S^E$ / Pa^{-1}	η / mPa·s	$\Delta\eta$ / mPa·s	ΔG^{*E} / J·mol^{-1}	n_D	Δn_D
293.15 K											
0.0000	998.20	0.000	2.119	0.000	1482.52	0.000	1.05	0.000	0.00	1.3340	0.00000
0.0978	1016.19	-0.617	6.186	1.965	1738.92	-1.463	6.76	5.235	4147.73	1.3921	0.00631
0.1982	1018.89	-1.017	7.364	2.083	1731.41	-1.462	18.26	16.039	5912.10	1.4208	0.00888
0.2957	1014.71	-1.155	7.383	1.489	1686.27	-1.251	28.68	25.463	6229.61	1.4360	0.00899
0.3970	1009.27	-1.159	7.375	1.060	1641.46	-1.009	39.11	34.394	6071.66	1.4452	0.00780
0.4958	1004.09	-1.072	7.323	0.716	1604.42	-0.786	45.73	38.886	5492.02	1.4506	0.00602
0.5935	999.33	-0.917	7.280	0.457	1574.10	-0.587	50.05	40.149	4711.38	1.4543	0.00439
0.6956	995.01	-0.713	7.264	0.266	1548.23	-0.404	51.50	36.934	3692.97	1.4572	0.00298
0.7979	991.43	-0.494	7.279	0.141	1527.38	-0.248	51.65	30.199	2575.62	1.4594	0.00175
0.8940	988.31	-0.248	7.301	0.057	1510.73	-0.117	51.65	20.805	1495.23	1.4613	0.00101
1.0000	985.67	0.000	7.342	0.000	1496.77	0.000	46.05	0.000	0.00	1.4627	0.00000
298.15 K											
0.0000	997.05	0.000	2.565	0.000	1496.80	0.000	0.90	0.000	0.00	1.3331	0.00000
0.0978	1013.00	-0.593	6.341	1.839	1727.94	-1.399	5.35	4.064	4059.50	1.3905	0.00598
0.1982	1015.12	-0.984	7.459	1.981	1717.11	-1.420	13.77	11.911	5765.79	1.4190	0.00853
0.2957	1010.94	-1.125	7.483	1.441	1671.56	-1.224	21.14	18.495	6065.45	1.4342	0.00874
0.3970	1005.53	-1.135	7.465	1.036	1626.62	-0.992	28.75	24.922	5931.15	1.4433	0.00752
0.4958	1000.40	-1.053	7.403	0.706	1589.56	-0.776	33.30	27.813	5350.14	1.4487	0.00579
0.5935	995.67	-0.903	7.355	0.459	1559.06	-0.580	36.52	28.685	4593.14	1.4524	0.00420
0.6956	991.38	-0.705	7.327	0.271	1533.11	-0.401	38.12	26.751	3626.27	1.4553	0.00282
0.7979	987.82	-0.490	7.331	0.146	1512.16	-0.246	38.33	21.820	2530.01	1.4575	0.00161
0.8940	984.70	-0.247	7.344	0.062	1495.39	-0.116	38.31	14.869	1461.16	1.4594	0.00089
1.0000	982.05	0.000	7.372	0.000	1481.33	0.000	34.50	0.000	0.00	1.4609	0.00000
303.15 K											
0.0000	994.03	0.000	3.010	0.000	1509.53	0.000	0.79	0.000	0.00	1.3322	0.00000
0.0978	1006.45	-0.571	6.496	1.713	1716.80	-1.341	4.42	3.300	4006.30	1.3889	0.00568
0.1982	1007.48	-0.952	7.555	1.880	1702.63	-1.382	10.86	9.267	5658.63	1.4172	0.00823

0.2957	1003.31	-1.097	7.582	1.394	1656.36	-1.200	16.31	14.066	5937.07	1.4323	0.00846
0.3970	997.97	-1.110	7.556	1.013	1611.59	-0.978	21.90	18.700	5799.91	1.4414	0.00732
0.4958	992.94	-1.034	7.484	0.697	1574.83	-0.769	25.07	20.533	5209.02	1.4467	0.00555
0.5935	988.31	-0.889	7.430	0.462	1543.96	-0.575	27.41	21.017	4461.74	1.4504	0.00400
0.6956	984.08	-0.696	7.391	0.276	1517.78	-0.397	28.15	18.988	3468.73	1.4533	0.00265
0.7979	980.55	-0.484	7.383	0.152	1496.98	-0.245	28.83	15.692	2431.52	1.4555	0.00147
0.8940	977.46	-0.244	7.387	0.066	1480.08	-0.115	29.47	11.036	1430.64	1.4574	0.00078
1.0000	974.81	0.000	7.403	0.000	1465.91	0.000	26.78	0.000	0.00	1.4590	0.00000
308.15 K											
0.0000	994.03	0.000	3.455	0.000	1520.29	0.000	0.69	0.000	0.00	1.3314	0.00000
0.0978	1006.45	-0.550	6.651	1.588	1705.28	-1.291	3.73	2.761	4013.42	1.3876	0.00542
0.1982	1007.48	-0.922	7.650	1.780	1688.00	-1.349	8.78	7.421	5612.26	1.4157	0.00790
0.2957	1003.31	-1.069	7.682	1.347	1641.36	-1.180	12.76	10.858	5835.10	1.4308	0.00819
0.3970	997.97	-1.087	7.646	0.990	1596.47	-0.967	17.17	14.483	5726.92	1.4399	0.00711
0.4958	992.94	-1.016	7.564	0.688	1559.75	-0.763	20.22	16.460	5225.68	1.4452	0.00536
0.5935	988.31	-0.875	7.505	0.465	1528.83	-0.571	21.73	16.479	4446.77	1.4489	0.00384
0.6956	984.08	-0.686	7.454	0.281	1502.71	-0.395	22.37	14.924	3469.99	1.4518	0.00251
0.7979	980.55	-0.478	7.435	0.157	1481.63	-0.243	22.88	12.315	2438.83	1.4540	0.00135
0.8940	977.46	-0.241	7.430	0.071	1464.88	-0.115	23.35	8.673	1442.26	1.4559	0.00066
1.0000	974.81	0.000	7.433	0.000	1450.59	0.000	21.09	0.000	0.00	1.4576	0.00000
313.15 K											
0.0000	992.22	0.000	3.901	0.000	1529.42	0.000	0.61	0.000	0.00	1.3305	0.00000
0.0978	1003.07	-0.531	6.806	1.464	1693.90	-1.247	3.18	2.331	4011.77	1.3861	0.00518
0.1982	1003.61	-0.893	7.746	1.681	1672.92	-1.319	7.25	6.072	5580.17	1.4140	0.00764
0.2957	999.43	-1.043	7.782	1.300	1626.16	-1.163	10.25	8.616	5758.91	1.4289	0.00784
0.3970	994.13	-1.063	7.736	0.968	1581.28	-0.957	13.63	11.349	5644.25	1.4381	0.00693
0.4958	989.17	-0.997	7.645	0.679	1544.61	-0.757	15.94	12.772	5140.47	1.4433	0.00514
0.5935	984.58	-0.861	7.580	0.468	1514.04	-0.570	17.07	12.688	4363.91	1.4470	0.00365
0.6956	980.41	-0.677	7.517	0.286	1487.62	-0.394	17.33	11.178	3360.36	1.4499	0.00235
0.7979	976.90	-0.473	7.487	0.163	1466.54	-0.243	17.86	9.218	2357.62	1.4521	0.00121
0.8940	973.82	-0.238	7.473	0.076	1449.56	-0.113	18.17	6.276	1360.62	1.4540	0.00055
1.0000	971.19	0.000	7.463	0.000	1435.41	0.000	16.92	0.000	0.00	1.4558	0.00000

[a] Standard uncertainties u are: $u(T)$ =0.01 K for density, speed of sound and viscosity and $u(T)$ = 0.1 K for refractive index, $u(p)$ = 10 kPa, $u(x_1)$ = $1 \cdot 10^{-4}$, $u(\rho)$ = 0.035 kg·m^{-3}, $u(u)$ = 0.2 m·s^{-1}, $u_r(\eta)$ = 1% , $u(n_D)$ = 0.0002

Table S4. Densities ρ, excess molar volumes V^E, isobaric thermal expansion coefficients α_p , excess thermal expansion $\Delta\alpha_p$, speed of sound u, excess isentropic compressibilities k_S^E, viscosities η, viscosity deviations $\Delta\eta$, excess Gibbs free energy of activation of viscous flow ΔG^{*E}, refractive indices n_D, refractive index deviations Δn_D as functions of mole fraction, x_1 of DES for TBAB:BAE (DES4) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure. [a]

x_1	ρ / kg·m^{-3}	$10^6\ V_m^E$ / m^3·mol^{-1}	$10^4\ \alpha_p$ / K^{-1}	$10^4\Delta\alpha_p$ / K^{-1}	u / m·s^{-1}	$10^{10}\ k_S^E$ / Pa^{-1}	η / mPa·s	$\Delta\eta$ / mPa·s	ΔG^{*E} / J·mol^{-1}	n_D	Δn_D
293.15 K											
0.0000	998.20	0.000	2.119	0.000	1482.52	0.000	1.05	0.000	0.00	1.334	0.00000
0.0975	987.04	-0.583	6.633	1.805	1605.54	-1.196	8.64	7.086	4982.17	1.3999	0.00554
0.1951	976.01	-0.879	7.459	1.543	1580.95	-1.160	20.06	17.758	6430.49	1.4261	0.00750
0.2936	967.54	-1.030	7.684	1.177	1548.49	-0.980	33.26	29.838	6827.16	1.4391	0.00735
0.3943	960.63	-1.069	7.754	0.874	1521.14	-0.791	46.71	41.580	6664.02	1.4464	0.00631
0.4930	955.07	-1.019	7.753	0.624	1499.17	-0.620	54.37	46.739	5974.18	1.4509	0.00525
0.5925	950.31	-0.896	7.738	0.426	1480.24	-0.461	60.92	49.533	5120.29	1.4537	0.00399
0.6975	946.07	-0.708	7.726	0.269	1463.88	-0.314	62.40	45.023	3933.83	1.4558	0.00286
0.7920	942.81	-0.502	7.731	0.171	1451.18	-0.196	62.48	37.068	2782.20	1.4573	0.00208
0.8938	939.77	-0.247	7.718	0.069	1440.66	-0.091	60.29	22.015	1421.51	1.4585	0.00129
1.0000	937.31	0.000	7.725	0.000	1431.73	0.000	58.66	0.000	0.00	1.4589	0.00000
298.15 K											
0.0000	997.05	0.000	2.565	0.000	1496.80	0.000	0.90	0.000	0.00	1.3331	0.00000
0.0975	983.73	-0.557	6.769	1.693	1596.27	-1.152	6.85	5.536	4912.72	1.3984	0.00537
0.1951	972.34	-0.847	7.570	1.488	1567.74	-1.132	15.28	13.361	6321.05	1.4244	0.00731
0.2936	963.80	-0.999	7.793	1.165	1533.63	-0.961	25.00	22.181	6725.16	1.4372	0.00705
0.3943	956.88	-1.041	7.871	0.896	1505.66	-0.778	34.26	30.101	6533.68	1.4445	0.00608
0.4930	951.35	-0.996	7.837	0.633	1483.43	-0.611	39.21	33.109	5824.06	1.4490	0.00506
0.5925	946.62	-0.878	7.811	0.438	1464.64	-0.457	43.81	34.829	4982.49	1.4518	0.00382
0.6975	942.40	-0.695	7.787	0.279	1448.91	-0.318	45.11	31.617	3825.30	1.4539	0.00271
0.7920	939.16	-0.493	7.776	0.174	1435.02	-0.192	45.50	26.028	2704.65	1.4554	0.00195
0.8938	936.14	-0.243	7.757	0.073	1424.82	-0.092	44.27	15.354	1375.95	1.4565	0.00108
1.0000	933.69	0.000	7.754	0.000	1415.72	0.000	43.66	0.000	0.00	1.4571	0.00000
303.15 K											
0.0000	995.65	0.000	3.010	0.000	1509.53	0.000	0.79	0.000	0.00	1.3322	0.00000
0.0975	980.38	-0.534	6.904	1.581	1587.12	-1.117	5.65	4.507	4874.04	1.3969	0.00526
0.1951	968.65	-0.818	7.681	1.433	1553.86	-1.106	12.20	10.555	6259.26	1.4226	0.00709

0.2936	960.03	-0.969	7.903	1.153	1518.73	-0.945	19.53	17.157	6650.31	1.4353	0.00684
0.3943	953.10	-1.012	7.987	0.920	1490.41	-0.768	25.84	22.381	6400.73	1.4425	0.00583
0.4930	947.61	-0.973	7.921	0.642	1467.70	-0.604	29.54	24.534	5709.66	1.4470	0.00485
0.5925	942.91	-0.859	7.885	0.451	1449.33	-0.456	32.86	25.589	4876.35	1.4498	0.00365
0.6975	938.73	-0.682	7.847	0.290	1432.25	-0.309	33.81	23.043	3733.45	1.4519	0.00256
0.7920	935.51	-0.483	7.822	0.178	1418.25	-0.184	34.21	18.867	2633.52	1.4534	0.00182
0.8938	932.51	-0.238	7.796	0.077	1408.61	-0.088	33.47	11.005	1331.17	1.4545	0.00096
1.0000	930.07	0.000	7.783	0.000	1399.85	0.000	33.43	0.000	0.00	1.4552	0.00000
308.15 K											
0.0000	994.03	0.000	3.455	0.000	1520.29	0.000	0.69	0.000	0.00	1.3314	0.00000
0.0975	976.97	-0.511	7.040	1.471	1577.06	-1.084	4.69	3.708	4861.36	1.3954	0.00514
0.1951	964.91	-0.789	7.793	1.379	1539.85	-1.082	9.91	8.511	6243.95	1.4208	0.00690
0.2936	956.21	-0.939	8.012	1.141	1503.75	-0.930	15.55	13.552	6620.04	1.4333	0.00657
0.3943	949.28	-0.982	8.104	0.943	1474.09	-0.753	20.44	17.562	6380.94	1.4405	0.00565
0.4930	943.84	-0.948	8.005	0.652	1451.90	-0.596	22.94	18.826	5661.78	1.4449	0.00463
0.5925	939.19	-0.839	7.958	0.464	1433.59	-0.451	25.10	19.196	4803.08	1.4477	0.00346
0.6975	935.04	-0.667	7.908	0.301	1416.38	-0.305	25.76	17.131	3667.46	1.4498	0.00241
0.7920	931.85	-0.474	7.867	0.182	1402.68	-0.183	26.39	14.240	2610.80	1.4513	0.00168
0.8938	928.87	-0.234	7.835	0.081	1392.95	-0.087	25.82	8.252	1318.63	1.4524	0.00085
1.0000	926.45	0.000	7.813	0.000	1384.17	0.000	25.81	0.000	0.00	1.4532	0.00000
313.15 K											
0.0000	992.22	0.000	3.901	0.000	1529.42	0.000	0.61	0.000	0.00	1.3305	0.00000
0.0975	973.50	-0.490	7.176	1.681	1566.84	-1.057	3.92	3.062	4827.81	1.3941	0.00493
0.1951	961.13	-0.761	7.904	1.609	1526.93	-1.069	8.14	6.932	6217.66	1.4194	0.00667
0.2936	952.37	-0.909	8.122	1.366	1488.46	-0.915	12.92	11.208	6658.46	1.4319	0.00639
0.3943	945.41	-0.950	8.221	1.148	1459.07	-0.747	16.24	13.811	6330.27	1.4391	0.00549
0.4930	940.05	-0.923	8.089	0.797	1436.26	-0.591	17.98	14.546	5593.38	1.4434	0.00438
0.5925	935.44	-0.819	8.032	0.578	1417.33	-0.444	19.50	14.634	4727.97	1.4462	0.00323
0.6975	931.33	-0.652	7.968	0.384	1400.79	-0.304	20.08	13.044	3612.81	1.4483	0.00219
0.7920	928.18	-0.464	7.913	0.224	1388.11	-0.190	20.42	10.629	2548.67	1.4499	0.00157
0.8938	925.23	-0.229	7.874	0.105	1377.38	-0.087	20.29	6.295	1305.52	1.4510	0.00074
1.0000	922.83	0.000	7.842	0.000	1368.57	0.000	20.30	0.000	0.00	1.4519	0.00000

[a] Standard uncertainties u are: $u(T)$ =0.01 K for density, speed of sound and viscosity and $u(T)$ = 0.1 K for refractive index, $u(p)$ = 10 kPa, $u(x_1)$ = $1 \cdot 10^{-4}$, $u(\rho)$ = 0.035 kg·m^{-3}, $u(u)$ = 0.2 m·s^{-1}, $u_r(\eta)$ = 1% , $u(n_D)$ = 0.0002

Table S5 Parameters of the JAM equation, together with *RMSD* and *ARD%* for density, speed of sound, viscosity and refractive index of DES (1) + water (2) systems at different temperatures.

T / K	293.15	298.15	303.15	308.15	313.15	293.15	298.15	303.15	308.15	313.15
					ρ / kg·m^{-3}					
		DES1 (1) + water (2)					DES2 (1) + water (2)			
A_0	24.8275	23.7395	22.6995	21.7383	20.8103	5.7143	4.2731	2.8780	1.5468	0.2672
A_1	-27.0200	-25.8625	-24.7000	-23.6118	-22.6113	-13.9849	-12.6833	-11.3833	-10.1036	-8.8636
A_2	26.7075	24.7500	23.0350	21.3838	19.9113	16.3915	14.9069	13.3060	11.7903	10.3483
A_3	-17.9650	-16.4675	-15.1600	-13.9238	-12.6038	-9.7227	-7.6083	-5.9668	-4.4809	-3.0999
A_4	-	-	-	-	-	-0.5512	-1.9659	-2.6380	-3.2256	-3.7564
R^2	0.9999	0.9999	0.9999	0.9999	0.9999	0.9996	0.9994	0.9993	0.9992	0.9990
RMSD	0.00017	0.00016	0.00013	0.00013	0.00013	0.00014	0.00014	0.00013	0.00011	0.00010
ARD%	0.0094	0.0086	0.0068	0.0063	0.0064	0.0073	0.0074	0.0067	0.0060	0.0054
		DES3 (1) + water (2)					DES4 (1) + water (2)			
A_0	13.5545	12.3320	11.1835	10.0645	8.9810	-15.2749	-17.2111	-19.0931	-20.9427	-22.7449
A_1	-21.6575	-20.4875	-19.3300	-18.2375	-17.1650	6.3675	7.8770	9.3910	10.8915	12.4003
A_2	29.3125	27.2200	25.2725	23.4350	21.7125	-4.3187	-5.4068	-6.4975	-7.5559	-8.5685
A_3	-23.8975	-21.7775	-19.915	-18.1625	-16.5600	-4.6725	-1.7230	0.9155	3.3840	5.6678
A_4	-	-	-	-	-	7.7956	4.6164	1.7841	-0.8624	-3.3666
R^2	0.9991	0.9992	0.9993	0.9993	0.9994	0.9995	0.9998	0.9995	0.9999	0.9999
RMSD	0.00037	0.00032	0.00027	0.00024	0.00020	0.00016	0.00011	0.00008	0.00005	0.00004
ARD%	0.020	0.017	0.015	0.012	0.010	0.0087	0.0062	0.0039	0.0026	0.0018
					u / m·s^{-1}					
		DES1 (1) + water (2)					DES2 (1) + water (2)			
A_0	126.286	116.013	108.149	100.740	92.017	136.992	128.015	120.735	111.169	103.579
A_1	-127.313	-121.125	-113.488	-106.725	-101.388	-138.025	-133.000	-126.000	-121.438	-115.475
A_2	114.750	112.000	112.450	106.125	99.588	126.350	125.250	122.000	117.500	112.213
A_3	-258.188	-243.875	-228.613	-214.475	-201.663	-263.275	-242.500	-225.000	-209.063	-193.475

A_4	234.594	206.188	177.731	161.500	145.525	248.038	225.250	203.875	186.656	172.494
R^2	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9992	0.9993	0.9992	0.9992
RMSD	0.0025	0.0024	0.0020	0.0022	0.0016	0.0023	0.0026	0.0034	0.0023	0.0021
%ARD	0.14	0.13	0.11	0.12	0.09	0.12	0.15	0.19	0.13	0.12
		DES3 (1) + water (2)					DES4 (1) + water (2)			
A_0	86.371	79.321	67.809	59.512	51.428	34.050	22.706	11.316	0.518	-9.699
A_1	-106.713	-98.563	-93.988	-87.900	-81.000	-41.275	-32.387	-25.325	-16.862	-9.175
A_2	96.600	93.250	87.200	82.975	77.875	28.975	25.025	14.037	9.713	9.487
A_3	-293.088	-272.938	-254.113	-236.400	-221.500	-179.525	-162.913	-146.125	-130.338	-113.775
A_4	307.944	284.219	264.731	244.288	227.063	213.100	189.619	177.631	158.275	135.331
R^2	0.9981	0.9982	0.9983	0.9983	0.9983	0.9957	0.9955	0.9951	0.9948	0.9946
RMSD	0.0044	0.0044	0.0039	0.003	0.0027	0.0032	0.0027	0.0024	0.0020	0.0017
%ARD	0.22	0.22	0.20	0.15	0.13	0.16	0.14	0.12	0.10	0.08
					η / mPa·s					
		DES1 (1) + water (2)					DES2 (1) + water (2)			
A_0	2197.11	2136.93	2070.94	2019.88	1968.01	2097.76	2027.09	1961.63	1929.09	1877.78
A_1	-1403.39	-1356.08	-1317.26	-1308.93	-1310.74	-1544.04	-1499.41	-1459.13	-1336.26	-1291.43
A_2	1449.19	1447.63	1428.56	1539.63	1614.44	1287.94	1331.56	1407.88	1493.06	1646.63
A_3	-450.26	-515.33	-644.89	-599.68	-583.61	-518.41	-517.04	-501.88	-831.89	-924.68
R^2	0.9998	0.9998	0.9997	0.9996	0.9996	0.9994	0.9994	0.9995	0.9995	0.9998
RMSD	0.016	0.016	0.017	0.021	0.019	0.027	0.025	0.023	0.022	0.014
%ARD	0.89	0.90	0.97	1.14	1.11	1.57	1.47	1.35	1.31	0.79
		DES3 (1) + water (2)					DES4 (1) + water (2)			
A_0	2186.81	2114.56	2034.01	2009.49	1958.05	2307.65	2227.63	2157.71	2120.71	2307.65
A_1	-1527.24	-1458.39	-1475.74	-1383.16	-1380.75	-1459.50	-1458.38	-1447.00	-1483.13	-1459.50
A_2	1537.94	1511.69	1500.44	1499.06	1478.75	707.25	756.63	814.38	822.75	707.25
A_3	-936.61	-944.76	-875.61	-1011.79	-1100.25	-1744.50	-1682.63	-1697.50	-1607.38	-1744.50
A_4	-	-	-	-	-	1861.75	1748.00	1651.56	1659.44	1861.75
R^2	0.9994	0.9994	0.9991	0.9984	0.9982	0.9994	0.9992	0.9993	0.9991	0.9992

RMSD	0.029	0.027	0.032	0.041	0.042	0.031	0.033	0.030	0.032	0.032
%ARD	1.66	1.54	1.84	2.24	2.31	1.63	1.76	1.62	1.72	1.72
					n_D					
		DES1 (1) + water (2)					DES2 (1) + water (2)			
A_0	47.4950	47.9388	48.3913	48.7650	49.0938	45.5112	45.9000	46.3138	46.7975	47.1188
A_1	-36.1950	-36.4238	-36.6013	-36.5350	-36.5387	-32.7513	-33.5775	-33.6663	-34.5525	-34.8613
A_2	34.4450	34.8513	35.4238	35.6050	35.9413	36.2188	36.4450	36.0763	36.3975	36.1013
A_3	-24.9000	-25.5913	-26.3188	-27.5150	-28.4463	-28.1588	-27.6875	-29.1488	-29.4275	-30.1938
R^2	0.9996	0.9996	0.9996	0.9995	0.9995	0.9993	0.9993	0.9993	0.9994	0.9994
RMSD	0.00055	0.00053	0.00053	0.00056	0.00059	0.00068	0.00067	0.00065	0.00063	0.00061
%ARD	0.032	0.031	0.031	0.032	0.035	0.038	0.037	0.037	0.035	0.034
		DES3 (1) + water (2)					DES4 (1) + water (2)			
A_0	43.7650	44.1175	44.4300	44.8650	45.1475	45.1613	45.4413	45.7138	45.9388	46.3888
A_1	-34.9100	-35.2425	-35.5825	-35.9075	-36.1875	-36.0987	-36.3288	-36.6013	-36.8012	-37.4362
A_2	35.4550	35.4125	35.3850	35.3950	35.4025	46.8688	47.0938	47.4063	47.6563	48.1063
A_3	-26.8750	-26.7625	-26.6325	-26.7675	-26.9275	-42.2863	-43.1663	-43.7638	-44.2138	-44.2988
R^2	0.9993	0.9994	0.9994	0.9994	0.9994	0.9981	0.9981	0.9981	0.9981	0.9982
RMSD	0.00064	0.00061	0.00059	0.00059	0.00058	0.0012	0.0011	0.0011	0.0011	0.0011
%ARD	0.036	0.034	0.033	0.032	0.033	0.064	0.064	0.064	0.063	0.063

Table S6. Parameters A_i of Eq. (6) and the corresponding *RSMD* f for TBAB:AP (DES1) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure.

Function	T / K	A_0	A_1	A_2	A_3	A_4	RMSD
				DES1 (1) + water (2)			
$10^6\,V^E$ / m^3·mol^{-1}	293.15	-3.840	1.863	-0.129	-	-	0.018
	298.15	-3.749	1.754	-0.007	-	-	0.018
	303.15	-3.669	1.631	0.079	-	-	0.018
	308.15	-3.584	1.531	0.169	-	-	0.018
	313.15	-3.499	1.428	0.223	-	-	0.018
$10^4\,\Delta\alpha_p$ / K^{-1}	293.15	3.016	-6.327	11.333	-7.618	-	0.023
	298.15	2.999	-6.024	10.333	-7.210	-	0.019
	303.15	3.012	-5.738	9.335	-6.808	-	0.035
	308.15	2.930	-5.450	8.342	-6.409	-	0.015
	313.15	2.905	-5.157	7.353	-6.013	-	0.015
$10^{10}\,k_S^E$ / Pa^{-1}	293.15	-2.532	2.831	-2.489	7.174	-7.083	0.0084
	298.15	-2.451	2.745	-2.487	6.687	-6.168	0.0076
	303.15	-2.385	2.648	-2.562	6.213	-5.288	0.0074
	308.15	-2.311	2.590	-2.470	5.796	-4.740	0.0067
	313.15	-2.269	2.518	-2.384	5.430	-4.231	0.0056
$\Delta\eta$ / mPa·s	293.15	210.80	172.56	63.53	124.95	-	0.28
	298.15	150.86	115.90	41.61	86.34	-	0.15
	303.15	111.51	80.56	23.86	52.64	-	0.14
	308.15	83.62	54.50	26.76	55.38	-	0.09
	313.15	63.96	37.74	24.30	47.84	-	0.08
ΔG^E / J·mol^{-1}	293.15	21652	-14563	13324	-	-	84
	298.15	21233	-14378	13376	-	-	93
	303.15	20769	-14423	13306	-	-	112
	308.15	20408	-14287	14249	-	-	110
	313.15	20046	-14306	14901	-	-	108
Δn_D	293.15	0.02405	-0.02670	0.01050	-	-	0.000098
	298.15	0.02333	-0.02580	0.01018	-	-	0.000095
	303.15	0.02248	0.02475	0.01058	-	-	0.000081
	308.15	0.02158	0.02365	0.00953	-	-	0.000061
	313.15	0.02100	0.02250	0.00940	-	-	0.000049

Table S7. Parameters A_i of Eq. (6) and the corresponding *RSMD* for TBAC:AP (DES2) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure.

Function	T / K	A_0	A_1	A_2	A_3	A_4	*RMSD*
				DES2 (1) + water (2)			
$10^6\,V^E$ / m^3·mol^{-1}	293.15	-3.892	1.937	-0.511	-	-	0.013
	298.15	-3.801	1.815	-0.390	-	-	0.013
	303.15	-3.710	1.706	-0.297	-	-	0.012
	308.15	-3.621	1.603	-0.218	-	-	0.012
	313.15	-3.533	1.507	-0.147	-	-	0.011
	293.15	3.100	-5.499	11.699	-11.308	-	0.016

$10^4\ \Delta\alpha_p$ / K^{-1}	298.15	3.101	-5.451	10.574	-9.668	-	0.011
	303.15	3.088	-5.412	9.451	-8.033	-	0.008
	308.15	3.088	-5.366	8.333	-6.402	-	0.006
	313.15	3.087	-5.325	7.218	-4.775	-	0.008
$10^{10}\ k_S^E$ / Pa^{-1}	293.15	-2.674	2.973	-2.636	7.238	-7.503	0.0089
	298.15	-2.587	2.927	-2.676	6.588	-6.704	0.0090
	303.15	-2.508	2.870	-2.648	6.054	-5.996	0.0083
	308.15	-2.426	2.822	-2.610	5.580	-5.427	0.0073
	313.15	-2.379	2.757	-2.545	5.143	-4.959	0.0068
$\Delta\eta$ / mPa·s	293.15	186.34	107.75	7.62	119.36	-	0.48
	298.15	131.40	69.93	12.51	91.90	-	0.31
	303.15	96.61	47.32	17.87	76.02	-	0.21
	308.15	74.69	40.07	14.30	42.15	-	0.10
	313.15	57.16	30.35	18.05	31.69	-	0.06
ΔG^E / J·mol^{-1}	293.15	20791	-15851	11984	-	-	105
	298.15	20268	-15531	12383	-	-	104
	303.15	19795	-15202	13049	-	-	100
	308.15	19622	-15047	13933	-	-	141
	313.15	19271	-14950	15285	-	-	147
Δn_D	293.15	0.02351	0.02009	0.02854	0.01186	-	0.000056
	298.15	0.02213	0.02198	0.02683	0.00743	-	0.000062
	303.15	0.02174	0.02009	0.02271	0.01261	-	0.000045
	308.15	0.02006	0.02169	0.02104	0.01136	-	0.000061
	313.15	0.01940	0.02135	0.01775	0.01340	-	0.000050

Table S8 Parameters A_i of Eq. (6) and the corresponding *RSMD* for TBAB:MAE (DES3) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure.

Function	T / K	A_0	A_1	A_2	A_3	A_4	*RMSD*
				DES3 (1) + water (2)			
$10^6\ V^E$ / m^3·mol^{-1}	293.15	-4.274	2.720	-1.044	-	-	0.011
	298.15	-4.200	2.580	-0.924	-	-	0.011
	303.15	-4.126	2.452	-0.816	-	-	0.010
	308.15	-4.051	2.335	-0.717	-	-	0.010
	313.15	-3.977	2.221	-0.633	-	-	0.010
$10^4\ \Delta\alpha_p$ / K^{-1}	293.15	2.765	-5.444	7.854	-12.486	8.919	0.015
	298.15	2.732	-5.304	7.553	-11.321	7.769	0.014
	303.15	2.696	-5.166	7.256	-10.159	6.625	0.015
	308.15	2.672	-5.024	6.963	-9.000	5.485	0.014
	313.15	2.642	-4.891	6.668	-7.846	4.348	0.014
$10^{10}\ k_S^E$ / Pa^{-1}	293.15	-3.164	3.551	-2.920	8.644	-9.214	0.0120
	298.15	-3.106	3.531	-2.911	8.059	-8.443	0.0108
	303.15	-3.070	3.505	-2.864	7.535	-7.827	0.0097
	308.15	-3.036	3.489	-2.846	7.071	-7.230	0.0088
	313.15	-3.018	3.446	-2.814	6.704	-6.730	0.0082
$\Delta\eta$ / mPa·s	293.15	155.32	50.59	-29.09	71.03	-	0.16

	298.15	111.72	35.88	-17.09	48.62	-	0.10
	303.15	82.12	18.82	-11.04	44.44	-	0.11
	308.15	64.46	16.44	-8.22	29.55	-	0.11
	313.15	50.02	10.03	-7.77	20.57	-	0.09
	293.15	21711	-16843	14212	-	-	157
	298.15	21183	-16342	14037	-	-	157
ΔG^E / J·mol^{-1}	303.15	20579	-16359	13958	-	-	155
	308.15	20452	-15983	14035	-	-	183
	313.15	20103	-16232	13937	-	-	196
	293.15	0.02393	-0.03685	0.02643	-	-	0.000023
	298.15	0.02318	-0.03580	0.02423	-	-	0.000020
Δn_D	303.15	0.02245	-0.03500	0.02230	-	-	0.000027
	308.15	0.02163	-0.03415	0.02023	-	-	0.000024
	313.15	0.02088	-0.03335	0.01863	-	-	0.000035

Table S9 Parameters A_i of Eq. (6) and the corresponding *RSMD* for TBAB:BAE (DES4) + water mixtures at the temperatures (293.15 to 303.15) K and atmospheric pressure.

Function	T / K	A_0	A_1	A_2	A_3	A_4	*RMSD*
			DES4 (1) + water (2)				
$10^6\ V^E$ / m^3·mol^{-1}	293.15	-4.045	2.112	-0.822	-	-	0.019
	298.15	-3.954	1.994	-0.710	-	-	0.017
	303.15	-3.860	1.884	-0.621	-	-	0.016
	308.15	-3.763	1.779	-0.548	-	-	0.015
	313.15	-3.662	1.680	-0.490	-	-	0.014
$10^4\ \Delta\alpha_p$ / K^{-1}	293.15	2.570	-3.022	2.439	-13.078	15.448	0.026
	298.15	2.615	-3.185	2.404	-11.655	13.894	0.025
	303.15	2.632	-3.385	2.349	-10.245	12.347	0.025
	308.15	2.710	-3.521	2.324	-8.834	10.806	0.025
	313.15	3.299	-4.296	2.684	-9.634	11.835	0.030
$10^{10}\ k_S^E$ / Pa^{-1}	293.15	-2.469	2.659	-1.919	7.471	-8.403	0.0110
	298.15	-2.444	2.599	-1.975	7.146	-7.802	0.0100
	303.15	-2.436	2.580	-1.805	6.840	-7.601	0.0094
	308.15	-2.391	2.544	-1.838	6.581	-7.193	0.0083
	313.15	-2.366	2.535	-1.999	6.310	-6.681	0.0086
$\Delta\eta$ / mPa·s	293.15	190.38	80.90	-55.30	24.71	-	0.18
	298.15	135.50	48.85	-35.76	24.08	-	0.14
	303.15	100.35	30.76	-24.54	17.62	-	0.09
	308.15	76.61	17.27	-15.40	17.10	-	0.08
	313.15	59.55	6.93	-12.38	22.52	-	0.07
ΔG^E/ J·kmol^{-1}	293.15	23563	-19656	16934	-	-	299
	298.15	23008	-19563	16883	-	-	291
	303.15	22545	-19569	17015	-	-	289
	308.15	22329	-19709	17139	-	-	281
	313.15	22100	-19957	17170	-	-	260
Δn_D	293.15	0.02000	-0.02513	0.02695	-	-	0.000029
	298.15	0.01929	-0.02399	0.02551	-	-	0.000027
	303.15	0.01854	-0.02324	0.02481	-	-	0.000024
	308.15	0.01773	-0.02273	0.02413	-	-	0.000029
	313.15	0.01686	-0.02321	0.02319	-	-	0.000020

Table S10 Isobaric thermal expansion coefficient (α_p), isochoric molar heat capacity(C_P), Flory theory parameters: characteristic volume(V^*), reduce volume ($\tilde{V}$), characteristic pressure (P^*), and ratio of molecular surface to volume ratio (S_1/S_2) of DES to water.

DES	T / K	$10^4\,\alpha$ / K^{-1}	C_p / J·mol^{-1}·K^{-1}	$10^6\,V^*$ /m^{-3}·mol^{-1}	$\tilde{V}$	$10^8 P^*$ / Pa	S_1/S_2
DES1							
	293.15	7.334	257.4	91.563	1.188	7.199	0.571
	298.15	7.343	260.7	91.670	1.191	7.209	0.569
	303.15	7.351	264.0	91.780	1.194	7.215	0.566
	308.15	7.359	268.4	91.890	1.196	7.221	0.564
	313.15	7.368	272.8	92.003	1.199	7.226	0.562
DES2							
	293.15	7.305	249.8	90.515	1.187	7.111	0.573
	298.15	7.315	250.9	90.618	1.190	7.110	0.571
	303.15	7.325	252.9	90.721	1.193	7.115	0.568
	308.15	7.336	254.0	90.827	1.196	7.110	0.566
	313.15	7.346	256.1	90.934	1.199	7.108	0.564
DES3							
	293.15	7.342	187.7	94.326	1.188	5.550	0.565
	298.15	7.372	190.7	94.399	1.191	5.574	0.563
	303.15	7.403	194.7	94.473	1.195	5.601	0.561
	308.15	7.433	203.2	94.549	1.198	5.646	0.559
	313.15	7.463	212.4	94.627	1.202	5.690	0.557
DES4							
	293.15	7.725	284.2	130.676	1.196	5.255	0.507
	298.15	7.754	288.2	130.796	1.200	5.266	0.505
	303.15	7.783	290.6	130.918	1.203	5.270	0.503
	308.15	7.813	294.0	131.044	1.207	5.277	0.501
	313.15	7.842	297.9	131.173	1.210	5.282	0.499
Water							
	293.15	2.120	75.4	17.031	1.060	1.520	-
	298.15	2.565	75.3	16.843	1.073	1.945	-
	303.15	3.010	75.3	16.661	1.086	2.405	-
	308.15	3.455	75.2	16.485	1.099	2.898	-
	313.15	3.901	75.2	16.315	1.113	3.420	-

Table S11 Partial molar volumes of DESs and water in their binary mixtures at T = (293.15 to 313.15) K and at atmospheric pressure (0.1 MPa)[a]

x_1	$10^6\,\bar{V}_1$ / m^3·mol^{-1}	$10^6\,\bar{V}_2$ / m^3·mol^{-1}	$10^6\,\bar{V}_1$ / m^3·mol^{-1}	$10^6\,\bar{V}_2$ / m^3·mol^{-1}	$10^6\,\bar{V}_1$ /m^3·mol^{-1}	$10^6\,\bar{V}_2$ / m^3·mol^{-1}	$10^6\,\bar{V}_1$ / m^3·mol^{-1}	$10^6\,\bar{V}_2$ / m^3·mol^{-1}	$10^6\,\bar{V}_1$ / m^3·mol^{-1}	$10^6\,\bar{V}_2$ / m^3·mol^{-1}
T / K	293.15		298.15		303.15		308.15		313.15	
DES1 (1) + water (2)										
0.0000	102.91	18.05	103.60	18.07	104.32	18.09	105.00	18.12	105.65	18.16
0.0994	104.68	18.03	105.20	18.05	105.79	18.07	106.33	18.10	106.87	18.13
0.1981	106.03	17.98	106.45	17.98	106.96	18.01	107.42	18.03	107.89	18.06
0.2979	107.04	17.88	107.41	17.88	107.87	17.91	108.30	17.93	108.73	17.95
0.3961	107.75	17.75	108.10	17.73	108.54	17.77	108.95	17.79	109.36	17.82
0.4983	108.24	17.56	108.59	17.53	109.03	17.59	109.43	17.61	109.83	17.64
0.5987	108.53	17.32	108.90	17.29	109.32	17.37	109.73	17.41	110.13	17.44
0.6999	108.68	17.04	109.06	17.00	109.49	17.12	109.89	17.17	110.29	17.21
0.8000	108.74	16.71	109.13	16.67	109.55	16.83	109.95	16.90	110.36	16.95
0.9000	108.75	16.35	109.14	16.30	109.55	16.50	109.96	16.59	110.36	16.65
1.0000	108.74	15.94	109.14	15.88	109.54	16.13	109.95	16.24	110.35	16.31
V_i^o	108.74	18.05	109.14	18.07	109.54	18.09	109.95	18.12	110.35	18.16
DES2 (1) + water (2)										
0.0000	101.23	18.05	101.94	18.07	102.63	18.09	103.30	18.12	103.95	18.16
0.0986	103.22	18.04	103.78	18.06	104.32	18.08	104.87	18.11	105.40	18.14
0.1973	104.69	17.99	105.15	18.01	105.62	18.03	106.08	18.05	106.54	18.08
0.2961	105.74	17.91	106.15	17.92	106.57	17.93	106.99	17.95	107.41	17.98
0.3962	106.46	17.76	106.86	17.77	107.25	17.79	107.65	17.81	108.05	17.84
0.4925	106.91	17.57	107.30	17.58	107.69	17.60	108.08	17.63	108.48	17.66
0.5954	107.20	17.29	107.59	17.32	107.98	17.35	108.38	17.38	108.78	17.42
0.6946	107.34	16.97	107.74	17.01	108.14	17.05	108.53	17.1	108.93	17.15
0.7996	107.41	16.56	107.81	16.62	108.21	16.69	108.61	16.75	109.01	16.82
0.9019	107.43	16.12	107.83	16.20	108.23	16.28	108.62	16.37	109.02	16.45
1.0000	107.43	15.66	107.83	15.76	108.23	15.86	108.62	15.96	109.02	16.05
V_i^o	107.44	18.05	107.83	18.07	108.23	18.09	108.62	18.12	109.02	18.16
DES3 (1) + water (2)										
0.0000	104.00	18.05	104.75	18.07	105.47	18.09	106.18	18.12	106.88	18.16

0.0978	106.93	18.06	107.51	18.07	108.07	18.10	108.64	18.12	109.20	18.15
0.1982	109.00	18.05	109.48	18.06	109.95	18.08	110.42	18.10	110.90	18.13
0.2957	110.33	18.00	110.75	18.01	111.17	18.02	111.60	18.03	112.04	18.06
0.3970	111.17	17.88	111.57	17.88	111.98	17.89	112.39	17.90	112.80	17.92
0.4958	111.64	17.67	112.03	17.67	112.43	17.69	112.84	17.70	113.26	17.73
0.5935	111.87	17.38	112.27	17.39	112.68	17.41	113.09	17.43	113.51	17.46
0.6956	111.97	16.98	112.38	17.00	112.80	17.04	113.21	17.07	113.63	17.11
0.7979	112.01	16.50	112.43	16.55	112.84	16.59	113.26	16.65	113.69	16.70
0.8940	112.03	16.01	112.44	16.07	112.86	16.13	113.28	16.20	113.70	16.27
1.000	112.04	15.45	112.45	15.52	112.87	15.60	113.29	15.69	113.71	15.77
V_i^o	112.04	18.05	112.45	18.07	112.87	18.09	113.29	18.12	113.71	18.16
DES4 (1) + water (2)										
0.0000	149.34	18.05	150.27	18.07	151.17	18.09	152.06	18.12	152.94	18.16
0.0975	151.75	18.05	152.52	18.07	153.29	18.09	154.05	18.12	154.82	18.15
0.1951	153.45	18.02	154.13	18.04	154.81	18.06	155.50	18.08	156.19	18.11
0.2936	154.61	17.95	155.24	17.96	155.87	17.98	156.51	18.00	157.17	18.03
0.3943	155.37	17.81	155.97	17.82	156.58	17.83	157.21	17.85	157.84	17.88
0.4930	155.81	17.58	156.41	17.60	157.02	17.62	157.63	17.64	158.25	17.68
0.5925	156.06	17.27	156.67	17.30	157.27	17.33	157.89	17.36	158.51	17.40
0.6975	156.20	16.85	156.81	16.90	157.42	16.94	158.03	16.99	158.66	17.04
0.7920	156.26	16.41	156.87	16.47	157.49	16.53	158.10	16.59	158.72	16.66
0.8938	156.30	15.88	156.91	15.96	157.52	16.04	158.14	16.12	158.76	16.20
1.0000	156.32	15.29	156.93	15.40	157.54	15.50	158.15	15.59	158.77	15.68
V_i^o	156.32	18.05	156.93	18.07	157.54	18.09	158.15	18.12	158.77	18.16