Corrected Illustrations:

1. Corrected Abstract: All the abbreviations have been changed to non-italics.

Densities, viscosities and ultrasonic velocities have been measured for the two ternary mixtures containing morpholine (1) +1,4-dioxane (2) + nitrobenzene (3) and + toluene (3) at 308.15K over the entire range of mole fractions. Thermodynamic parameters like excess volume (VE), deviations in adiabatic compressibility (ΔKs), free length (ΔLF), isothermal compressibility (ΔβT), free volume (ΔVF ), viscosity (Δlnɳ) were calculated and applied to Redlich − Kister polynomial equation to determine the appropriate coefficients. The deviations of the ternary liquid mixtures from their ideal behaviour are determined from the measured and calculated thermodynamic properties. Also an insight in to the molecular structure and possible interactions for the investigated mixtures is attempted.

1. Corrected Table I: The symbols and units have been formatted.

Densities (ρ), viscosities (ɳ) and ultrasonic velocities (U) of pure morpholine, nitrobenzene 1,4- dioxane and toluene.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Compounds | *T/ K* | *ρ/ kg m-3* | *ɳ/ cP* | *U/ m s-1* |
| Exp | Lit | Exp | Lit | Exp | Lit |
| Morpholine19,20 | 308.15 | 0.9869 | 0.98630.9925 | 2.0977 | 2.0955 | 1420 | 1410 |
| Nitrobenzene21 | 308.15 | 1.1877 | 1.1911 | 1.5678 | 1.5543 | 1375 | 1379 |
| 1,4-dioxane22,23 | 308.15 | 1.0167 | 1.016681.01659 | 1.025 | 1.0281.014 | 1300 | 1300.3 |
| Toluene24,25 | 308.15 | 0.8378 | 0.8566(at 303.15K) | 0.5099 | 0.527(at 303.15K) | 1250 |  |

1. Corrected Table II: The symbols and units have been formatted

TABLE II. Thermodynamic transport properties for the ternary liquid mixtures of morpholine + 1,4-dioxane+nitrobenzene at 308.15K.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *X1* | *X2* | *ρ/ kg m-3* | *VE/ m3 mol-1* | *U/ m s-1* | *ɸ1* | *ɸ2* |
| 0.0563 | 0.4676 | 1.1051 | -0.0882 | 1370 | 0.0524 | 0.4274 |
| 0.0789 | 0.5073 | 1.0936 | -0.0871 | 1350 | 0.0742 | 0.4687 |
| 0.0647 | 0.5290 | 1.0929 | -0.1000 | 1360 | 0.0610 | 0.4895 |
| 0.1742 | 0.5240 | 1.0710 | -0.1050 | 1364 | 0.1671 | 0.4933 |
| 0.1300 | 0.6545 | 1.0565 | -0.1206 | 1330 | 0.1267 | 0.6265 |
| 0.1443 | 0.5808 | 1.0670 | -0.1087 | 1334 | 0.1391 | 0.5498 |
| 0.2481 | 0.3216 | 1.0913 | -0.0625 | 1356 | 0.2321 | 0.2953 |
| 0.1622 | 0.2727 | 1.1169 | -0.0765 | 1360 | 0.1483 | 0.2449 |
| 0.1635 | 0.7323 | 1.0332 | -0.0486 | 1328 | 0.1628 | 0.7156 |
| 0.1860 | 0.7332 | 1.0284 | -0.0908 | 1330 | 0.1859 | 0.7194 |
| 0.2184 | 0.6593 | 1.0322 | 0.2031 | 1324 | 0.2164 | 0.6414 |
| 0.2239 | 0.2655 | 1.1028 | 0.1982 | 1334 | 0.2066 | 0. 2404 |
| 0.2312 | 0.6790 | 1.0256 | 0.1880 | 1340 | 0.2304 | 0.6645 |
| 0.2549 | 0.3633 | 1.0821 | -0.0228 | 1356 | 0.2405 | 0.3365 |
| 0.2644 | 0.6731 | 1.0202 | 0.0981 | 1300 | 0.2648 | 0.6618 |
| 0.2955 | 0.3563 | 1.0749 | -0.0236 | 1350 | 0.2804 | 0.3319 |
| 0.3286 | 0.0819 | 1.1159 | -0.0557 | 1356 | 0.2985 | 0.0730 |
| 0.3292 | 0.3365 | 1.0722 | -0.0919 | 1358 | 0.3130 | 0.3140 |
| 0.3908 | 0.1457 | 1.0929 | -0.0627 | 1364 | 0.3626 | 0.1327 |
| 0.3703 | 0.3171 | 1.0668 | -0.0698 | 1374 | 0.3532 | 0.2969 |
| 0.3880 | 0.1855 | 1.0866 | -0.0663 | 1372 | 0.3624 | 0.1701 |
| 0.4323 | 0.2993 | 1.0568 | -0.0667 | 1372 | 0.4153 | 0.2823 |
| 0.4503 | 0.3123 | 1.0501 | -0.0311 | 1376 | 0.4148 | 0.2960 |
| 0.4996 | 0.3390 | 1.0341 | -0.0260 | 1380 | 0.4889 | 0.3257 |

TABLE II continuation………………….

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *ΔKs* | *ɳ/ cP* | *Δlnɳ/ cP* | *ΔLF X10-10/ K-1* | *ΔβΤ X10-12/ K-1* | *ΔLF X10-07/ m3mol-1* |
| -24.1217 | 1.2612 | -0.0790 | -2.0396 | -4.6571 | -1.6313 |
| -11.9790 | 1.1985 | -0.1306 | -1.7098 | -2.8968 | -1.6010 |
| -21.0593 | 1.2965 | -0.0143 | -0.8265 | -4.1598 | -1.5938 |
| -20.6202 | 1.2464 | -0.1175 | -0.5238 | -3.9033 | -1.5598 |
| -2.4442 | 1.1048 | -0.1680 | -0.1092 | -1.3684 | -1.4998 |
| -1.7110 | 1.1304 | -0.1889 | -0.2212 | -1.3028 | -1.5371 |
| -0.4043 | 1.3191 | -0.1885 | -0.5035 | -1.1682 | -1.6506 |
| -2.4442 | 1.3750 | -0.1195 | -0.8807 | -1.5255 | -1.7073 |
| -1.7110 | 1.0757 | -0.1703 | -0.8371 | -1.0378 | -1.4442 |
| -0.4043 | 1.0942 | -0.1617 | -0.7828 | -1.0795 | -1.4363 |
| -2.7728 | 1.0604 | -0.2504 | -0.7085 | 0.5059 | -1.4673 |
| -3.6062 | 1.3576 | -0.1692 | -1.4130 | -1.6677 | -1.6908 |
| -4.4400 | 1.0772 | -0.2289 | -0.8055 | -1.2732 | -1.4519 |
| 7.4277 | 1.1612 | -0.3269 | -1.4170 | -1.4045 | -1.6239 |
| 19.5153 | 1.1643 | -0.1602 | -0.2612 | 3.7882 | -1.4447 |
| 5.5176 | 1.2751 | -0.2354 | -1.2356 | -4.9321 | -1.6148 |
| -2.4875 | 1.3538 | -0.3207 | -1.5883 | 1.2305 | -1.7601 |
| 29.8909 | 1.4627 | -0.0740 | -1.2445 | -1.0445 | -1.6154 |
| 3.8725 | 1.5391 | -0.1294 | -1.3880 | 0.1304 | -1.7036 |
| 15.0459 | 1.5258 | -0.0404 | -1.3020 | -2.2554 | -1.6129 |
| -0.5578 | 1.3765 | -0.2092 | -1.4245 | -0.9903 | -1.6814 |
| -9.5182 | 1.5808 | -0.0235 | -1.1065 | -1.5260 | -1.6023 |
| -0.7945 | 1.6804 | 0.0747 | -1.0648 | -1.8432 | -1.5892 |
| -5.0662 | 1.8288 | 0.2149 | -0.8469 | -1.9956 | -1.5577 |

1. Corrected Table III: The symbols and units have been formatted

TABLE III. Thermodynamic transport properties for the ternary liquid mixtures of morpholine + 1,4-dioxane+toluene at 308.15K.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *X1* | *X2* | *ρ/ kg m-3* | *VE/ m3 mol-1* | *U/ m s-1* | *ɸ1* | *ɸ2* |
| 0.0477 | 0.4578 | 0.9248 | 0.0166 | 1280 | 0.0469 | 0.4555 |
| 0.0756 | 0.5013 | 0.9387 | -0.0049 | 1290 | 0.0744 | 0.4995 |
| 0.0781 | 0.5043 | 0.9407 | -0.0168 | 1280 | 0.0769 | 0.5024 |
| 0.1146 | 0.5171 | 0.9487 | -0.0195 | 1290 | 0.1130 | 0.5156 |
| 0.1121 | 0.4735 | 0.9424 | -0.0405 | 1282 | 0.1104 | 0.4719 |
| 0.1305 | 0.4508 | 0.9403 | -0.0321 | 1284 | 0.1285 | 0.4493 |
| 0.1572 | 0.3949 | 0.9337 | -0.0261 | 1290 | 0.1549 | 0.3936 |
| 0.1570 | 0.3537 | 0.9274 | -0.0387 | 1286 | 0.1546 | 0.3524 |
| 0.1612 | 0.3151 | 0.9203 | -0.0354 | 1280 | 0.1587 | 0.3139 |
| 0.2186 | 0.2884 | 0.9239 | -0.0281 | 1290 | 0.2155 | 0.2875 |
| 0.2066 | 0.2503 | 0.9201 | -0.0822 | 1280 | 0.2034 | 0.2494 |
| 0.2350 | 0.2269 | 0.9144 | -0.0184 | 1290 | 0.2316 | 0.2261 |
| 0.2409 | 0.3640 | 0.9399 | -0.0177 | 1286 | 0.2378 | 0.3634 |
| 0.2443 | 0.2782 | 0.9273 | -0.0435 | 1290 | 0.2409 | 0.2775 |
| 0.2435 | 0.0065 | 0.8825 | -0.0916 | 1274 | 0.2394 | 0.0065 |
| 0.2802 | 0.3778 | 0.9305 | 0.1780 | 1280 | 0.2768 | 0.3776 |
| 0.3172 | 0.3883 | 0.9090 | 0.5081 | 1290 | 0.3137 | 0.3884 |
| 0.3044 | 0.0966 | 0.9527 | -0.5729 | 1276 | 0.3000 | 0.0963 |
| 0.3532 | 0.4173 | 0.9302 | 0.3803 | 1286 | 0.3497 | 0.4179 |
| 0.3610 | 0.4471 | 0.9090 | 0.7011 | 1294 | 0.3576 | 0.4479 |
| 0.3978 | 0.4479 | 0.8972 | 0.9091 | 1292 | 0.3943 | 0.4491 |
| 0.3867 | 0.1397 | 0.9315 | -0.1300 | 1296 | 0.3819 | 0.1396 |
| 0.3952 | 0.1046 | 0.9090 | 0.0635 | 1316 | 0.3902 | 0.1045 |
| 0.3570 | 0.0949 | 0.8853 | 0.2553 | 1310 | 0.3522 | 0.0947 |

TABLE III continuation…………..

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *ΔKs* | *ɳ/ cP* | *Δlnɳ/ cP* | *ΔLF X10-11/ K-1* | *ΔβΤ X10-12/ K-1* | *ΔLF X10-09/ m3 mol-1* |
| -8.8433 | 0.5730 | -0.2994 | 8.5711 | -1.7429 | -6.6011 |
| -12.6698 | 0.6440 | -0.2854 | 5.9629 | -2.4475 | -6.3165 |
| -3.4661 | 0.6548 | -0.2793 | 7.0119 | -1.0570 | -6.2948 |
| -6.6581 | 0.6842 | -0.3065 | 5.2522 | -1.5440 | -6.0352 |
| -3.2808 | 0.7263 | -0.2431 | 7.1149 | -1.1156 | -6.1844 |
| -2.6529 | 0.7015 | -0.2846 | 7.3635 | -1.0779 | -6.1317 |
| -7.9157 | 0.6734 | -0.3277 | 7.8463 | -1.7450 | -6.1220 |
| -6.4852 | 0.6456 | -0.3384 | 9.2292 | -1.6720 | -6.2377 |
| -2.4236 | 0.5942 | -0.3801 | 10.0900 | -0.9508 | -6.3124 |
| -4.4115 | 0.6198 | -0.4245 | 10.0110 | -1.2576 | -6.0373 |
| -1.4974 | 0.5937 | -0.4180 | 11.8296 | -1.0168 | -6.2179 |
| -4.3844 | 0.6134 | -0.4289 | 11.4725 | -1.2562 | -6.1121 |
| 8.2209 | 0.7931 | -0.3134 | 8.6335 | 0.6184 | -5.7072 |
| -1.5954 | 0.6918 | -0.3845 | 9.9783 | -0.9420 | -5.9203 |
| -1.3257 | 0.9114 | -0.0531 | 18.3356 | -0.9221 | -6.7381 |
| 32.9812 | 1.0040 | -0.1633 | 10.3046 | 0.4898 | -5.4419 |
| 50.5900 | 1.0018 | -0.2220 | 11.0722 | 0.8325 | -5.1804 |
| -23.1576 | 0.7577 | -0.3294 | 11.5409 | -0.5619 | -6.0823 |
| 54.3454 | 0.6940 | -0.5924 | 9.7244 | 0.8502 | -4.8393 |
| 67.8794 | 0.8107 | -0.4987 | 10.3545 | 1.1543 | -4.7204 |
| 88.6874 | 0.7787 | -0.5828 | 11.8775 | 1.5141 | -4.4853 |
| 1.1146 | 1.1744 | -0.0461 | 11.0315 | -0.0754 | -5.4758 |
| -7.1118 | 1.2879 | 0.0069 | 10.9049 | -1.3617 | -5.5285 |
| 4.1838 | 1.1953 | 0.0347 | 13.5514 | 0.0885 | -5.7907 |

1. Corrected Table IV: The parameters have been highlighted:

TABLE IV: Coefficients of the Redlich – Kister (Equation-13) equation and standard deviation for the ternary mixture of morpholine + 1,4-dioxane + nitrobenzene at 308.15K.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameters | A | b | C | Σ |
| *VE / m3 mol-1* | -1.4183 | 19.8996 | 211.486 | 0.0022 |
| *ΔKs / TPa-1* | -1893.438 | -910.881 | 365.991 | 0.6498 |
| *ɳ / cP* | 46.1904 | 37.8175 | 1413.52 | 0.0166 |
| *Δɳ / cP* | -3.1614 | -2.7604 | -486.90 | 0.0006 |
| *ΔLFX10-08 / K-1* | -0.4484 | 1.0761 | -7.5793 | 0.0002 |
| *ΔβΤ X10-11/ K-1* | -2.1234 | -8.4693 | 613.310 | 0.0037 |
| *ΔVF X10-07/ m3 mol-1* | -0.4472 | -1.1541 | -17.881 | 1.3427 |

5. Corrected Table V: The parameters have been highlighted

TABLE V: Coefficients of the Redlich – Kister (Equation-13) equation and standard deviation for the ternary mixture of morpholine + 1,4-dioxane + toluene at 308.15K.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameters | A | b | C | Σ |
| *VE / m3 mol-1* | 2.1257 | 149.639 | 787.797 | 0.0016 |
| *ΔKs / TPa-1* | 551.687 | 15015.2 | 7775.7 | 0.1439 |
| *ɳ / cP* | 23.4643 | -34.7198 | 972.12 | 0.0127 |
| *Δɳ / cP* | -12.1066 | -42.3119 | 8.8834 | 0.0078 |
| *ΔLF X 10-98 / K-1* | 3.0210 | -4.0753 | 0.0104 | 0.0019 |
| *ΔβΤ X 10-11/ K-1* | 2.9982 | 264.08 | 1354.2 | 2.1010 |
| *ΔVF X 10-07/ m3 mol-1* | -2.0163 | 4.4961 | -2.0265 | 0.0022 |

6. Corrected references: The references have been formatted according to author’s instructions and the double spacing in between has been removed.

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