# Vapour-Liquid Equilibrium and Thermodynamic Functions for the Liquid System Carbon Tetrachloride + Acetone

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For the system carbon tetrachloride + acetone, we give the results of measurements on the vapour-liquid equilibrium carried out over the entire range of compositions at 20 °C, 25 °C, 30 °C, 35 °C, and 40 °C (17 measurements at 25 °C and 10 measurements at each of the other temperatures). The activity coefficients as well as the molar excess Gibbs function $\bar{G}^E$ for the liquid are derived from these experimental data. The system exhibits an azeotropic point (vapour pressure maximum) at each temperature. For 25 °C there exist published calorimetric data on the molar excess enthalpy $\bar{H}^E$ so that we can compute the molar excess entropy $\bar{S}^E$ for this temperature. While $\bar{G}^E$ and $\bar{H}^E$ are positive, $\bar{S}^E$ is negative. The "symmetry rule" (Haase, 1950) concerning the composition dependence of $\bar{G}^E$ has again been confirmed.

Using an equilibrium still of the Scatchard type [1, 2], we measured vapour pressures and vapour compositions under isothermal conditions for the liquid system carbon tetrachloride + acetone over the whole range of compositions at five temperatures (17 compositions at 25 °C and 10 compositions at 20 °C, 30 °C, 35 °C, and 40 °C). It turns out that the binary system exhibits an azeotropic point (vapour pressure maximum) at each temperature investigated (see Figure 1). The maximum shifts towards the acetone end of the diagram at lower temperatures and probably vanishes at about 15 °C.

We derive the activity coefficients $f_1$ and $f_2$ of the components (Fig. 2) and the molar excess Gibbs function $\bar{G}^E$ of the liquid mixture (Fig. 3 and Table 1) in the usual way. These thermodynamic functions (as well as other molar excess functions) practically only depend on the temperature $T$ and on the mole fraction $x$ of one of the components.

For 25 °C there exist calorimetric data [3] for the molar excess enthalpy (molar heat of mixing) $\bar{H}^E$ so that we are able to compute the molar excess entropy $\bar{S}^E$ ($T\bar{S}^E = \bar{H}^E - \bar{G}^E$) for this temperature (Figure 3). As far as the authors are aware, there are no other published data on the thermodynamic behaviour of the system at hand.

We show part of the details in the figures and in the table. (The complete data are given elsewhere [2].) We see that $\bar{G}^E$ and $\bar{H}^E$ are positive, while $\bar{S}^E$ is negative. We also notice that the symmetry rule [4, 5] again applies: For a given temperature, the

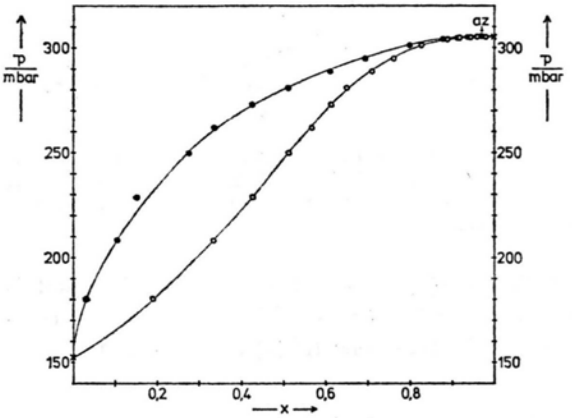

**Fig. 1.** System carbon tetrachloride + acetone at 25 °C: Vapour pressure $p$ as a function of the mole fraction $x$ of acetone (az denotes the azeotropic point).

Table 1. Liquid system carbon tetrachloride + acetone: Molar excess Gibbs function $\bar{G}^E$ as a function of the mole fraction $x$ of acetone (interpolated values).

| $x$ | $\bar{G}^E/\mathrm{J\cdot mol^{-1}}$ | | | | |
|---|---|---|---|---|---|
| | 20 °C | 25 °C | 30 °C | 35 °C | 40 °C |
| 0.05 | 135 | 122 | 150 | 125 | 120 |
| 0.1 | 245 | 240 | 260 | 225 | 220 |
| 0.15 | 328 | 322 | 340 | 310 | 310 |
| 0.2 | 390 | 390 | 395 | 380 | 375 |
| 0.25 | 438 | 442 | 442 | 430 | 430 |
| 0.3 | 475 | 482 | 480 | 475 | 475 |
| 0.35 | 502 | 515 | 510 | 508 | 505 |
| 0.4 | 520 | 535 | 530 | 530 | 530 |
| 0.45 | 530 | 545 | 540 | 545 | 540 |
| 0.5 | 530 | 545 | 540 | 550 | 548 |
| 0.55 | 520 | 530 | 530 | 542 | 540 |
| 0.6 | 490 | 500 | 510 | 520 | 520 |
| 0.65 | 450 | 460 | 480 | 490 | 490 |
| 0.7 | 400 | 420 | 430 | 440 | 442 |
| 0.75 | 350 | 370 | 375 | 380 | 390 |
| 0.8 | 290 | 310 | 315 | 320 | 325 |
| 0.85 | 230 | 240 | 245 | 250 | 255 |
| 0.9 | 160 | 170 | 170 | 180 | 180 |
| 0.95 | 80 | 90 | 90 | 90 | 90 |

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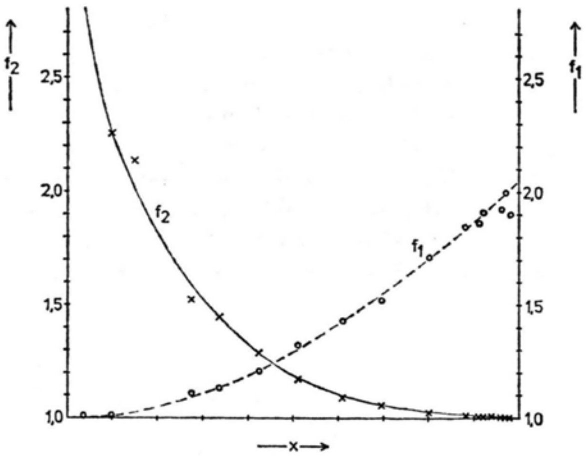

Fig. 2. Liquid system carbon tetrachloride (component 1) + acetone (component 2) at 25 °C: Activity coefficients $f_1$ and $f_2$ of the components as functions of the mole fraction $x$ of acetone.

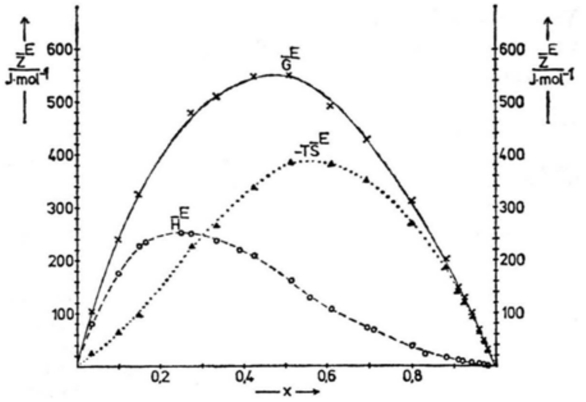

Fig. 3. Liquid system carbon tetrachloride + acetone at 25 °C: Molar excess Gibbs function $\bar{G}^E$, molar excess enthalpy $\bar{H}^E$ (after H. Loiseleur et al. [3]), and product $T\,\bar{S}^E$ of thermodynamic temperature $T$ and molar excess entropy $\bar{S}^E$ as functions of the mole fraction $x$ of acetone ($T\,\bar{S}^E = \bar{H}^E - \bar{G}^E$).

function $\bar{G}^E(x)$ does not change its sign and is nearly symmetric (parabolic), no matter how complicated the functions $\bar{H}^E(x)$ and $\bar{S}^E(x)$ are.

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