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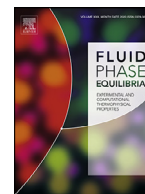
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# The impressive impact of including enthalpy and heat capacity of mixing data when parameterising equations of state. Application to the development of the *E*-PPR78 (*Enhanced*-Predictive-Peng-Robinson-78) model.



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## ABSTRACT

PPR78 (Predictive-Peng-Robinson78) is a well-established cubic equation of state in which, the temperature-dependent binary interaction parameters (bips) between two molecules  $i$  and  $j$  [ $k_{ij}(T)$ ] are predicted by a group-contribution method. In such a model, two group-binary-interaction parameters (G-bips), noted  $A_{kl}$  and  $B_{kl}$ , are required per  $(k,l)$  pair of groups. The purpose of this article is to demonstrate that the inclusion of enthalpy and heat capacity of mixing data in the process of optimisation of the G-bips leads to a remarkable overall reduction of the error on such properties, from 841.51% to 51.42%, while keeping constant the accuracy in the prediction of VLE data, 8.6% (without inclusion of mixing properties) to 8.8% (with inclusion of mixing thermal properties). This new version of the PPR78 model (with the new sets of  $A_{kl}$  and  $B_{kl}$  G-bips) has thus been called *Enhanced*-PPR78 (*E*-PPR78) model. From 2013 to 2017, this model was continuously developed and it is currently based on 40 groups. The many G-bips were fitted over 131,207 vapour liquid equilibrium data and 33,629 mixing properties data ( $h^M$  and  $c_p^M$ ) belonging to 1301 binary systems. After almost 18 years from the initial development of the PPR78 model, this paper summarizes for the first time the overall accuracy of the *E*-PPR78 model.

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## 1. Introduction

After eight years since the release of the *Enhanced*-Predictive-PPR78 equation of state (*E*-PPR78), this paper details the reason which drove our research group to develop this model, from the modification of the original PPR78.

The *predictive* character of PPR78 relies on its capability of calculating thermodynamic properties of multicomponent systems knowing: (i) pure-component characteristics (i.e., acentric factor, critical temperature and pressure, decomposition in elementary groups from the molecular structure) and (ii) group-binary-interaction parameters (G-bips), which allow the predictive determination of the temperature-dependent binary interaction parameters ( $k_{ij}$ ) between 2 components  $i$  and  $j$  by a group-contribution method. In the PPR78 model, two G-bips, noted  $A_{kl}$  and  $B_{kl}$ , are required per  $(k,l)$  pair of groups and this paper is devoted to high-

light the importance of properly selecting the type of experimental data underlying the process of optimisation of such G-bips.

The theoretical development of PPR78 was presented for the first time in 2004 [1]. In the years that followed, prior to 2015, the model was optimised over phase equilibrium data (liquid and gas phase compositions, critical pressures and compositions, azeotropic pressures and compositions) of binary mixtures [2–13], resulting in a model counting 21 groups (CH<sub>3</sub>, CH<sub>2</sub>, CH, C, aromatic carbon atom groups, cyclic carbon atom groups, double-bonded carbon atom groups, CO<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>S, -SH, H<sub>2</sub>O, H<sub>2</sub>). For these 21 groups, it was necessary to determine the values of 420 G-bips (210  $A_{kl}$  and 210  $B_{kl}$ ). Among the mostly applied predictive cubic equations of state (EoS), PPR78 proved to be one of the most accurate in modelling phase-equilibrium properties of multicomponent fluids containing non-associating compounds explaining why it is available in commercial process simulators like ProSimPlus, Simulis® Thermodynamics and PRO/II. However, as stated in 2001 by Agarwal et al. [14], “if you are modelling a system with significant excess enthalpies using a Gibbs free-energy-based EoS and you have a good VLE fit, this does not automatically ensure you a good overall model (from an energy balance point of view)”. With the aim to evaluate

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the applicability of the PPR78 model to the calculation of enthalpy changes and heat capacities so that it can be used to perform energy and exergy balances, Qian et al. published in 2013 [15] extended results about the capability of PPR78 to predict enthalpy and heat capacity changes of mixing. It was concluded that without being excessively high, the deviations between calculated and experimental data were not as accurate as expected so that there was room for improvement. In response to such an outcome, the 420 G-bips of the model were then re-optimised over both experimental VLE and property changes on mixing ( $h^M$  and  $c_p^M$ ) data. Despite the impressive gain in accuracy, the resulting parameters and the corresponding deviations remained unpublished until the writing of this paper. They however can be found in the thesis by Qian [16]. This increase in accuracy explains why, since 2015, published PPR78's G-bips have been optimised over, *simultaneously*, enthalpy and heat capacity of mixing in addition to phase equilibrium data [17–21].

This paper intends to report on the improved predictive capability of the version of PPR78, the G-bips of which were optimised over such an extended set of data ( $h^M$ ,  $c_p^M$ , VLE) and named *Enhanced-PPR78* (*E-PPR78*). After recalling the mathematical features of the PPR78 model (which formulation is equivalent to the one of the *E-PPR78* model) and of the optimisation framework, we present the results obtained in 2013 with the 21 first groups and the corresponding 420 G-bips optimised over VLE data, enthalpy and heat capacity of mixing properties. A comparison of this re-optimised model (*E-PPR78*) with the predictive capability of the original PPR78 model is also reported. From 2013 to 2017, 19 new groups were added so that the *E-PPR78* model includes currently 40 groups. For the first time, this paper presents the average modelling errors on the ensemble of data (more than 150,000 data points) considered to develop such a model.

## 2. From PPR78 to E-PPR78

### 2.1. PPR78 and E-PPR78, a unique mathematical formulation

The PPR78 model is a predictive version of the equation of state published in 1978 by Peng and Robinson [22], which we are used to refer to with the label PR78. As detailed below, such an EoS is made predictive through the development of a group contribution method to predict the temperature-dependent bips that appear in the classical Van der Waals one-fluid mixing rules.

The PR78 EoS can be written:

$$P = \frac{RT}{v-b} - \frac{a}{v(v+b) + b(v-b)} \quad (1)$$

When applied to the  $i$ -th pure component,  $a$  in eq. (1) corresponds to its specific cohesive parameter,  $a_i$ , and  $b$  to its co-volume,  $b_i$ , which are in turn calculated with the generalized functions reported in the following:

$$\left\{ \begin{array}{l} R = 8.314472 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \\ X = \left[ 1 + 3\sqrt{4 - 2\sqrt{2}} + 3\sqrt{4 + 2\sqrt{2}} \right]^{-1} \approx 0.253076587 \\ b_i = \Omega_b \frac{RT_{c,i}}{P_{c,i}} \text{ with } : \Omega_b = \frac{X}{X+3} \approx 0.0777960739 \\ a_i(T) = a_{c,i} \alpha_i(T) \text{ with } \left\{ \begin{array}{l} a_{c,i} = \Omega_a \frac{R^2 T_{c,i}^2}{P_{c,i}} \text{ and} \\ \Omega_a = \frac{8(5X+1)}{49-37X} \approx 0.457235529 \\ \alpha_i(T) = \left[ 1 + m_i \left( 1 - \sqrt{\frac{T}{T_{c,i}}} \right) \right]^2 \end{array} \right. \\ \text{if } \omega_i < 0.491 \text{ then } m_i = 0.37464 + 1.54226\omega_i - 0.26992\omega_i^2 \\ \text{if } \omega_i > 0.491 \text{ then } m_i = 0.379642 + 1.48503\omega_i \\ -0.164423\omega_i^2 + 0.016666\omega_i^3 \end{array} \right. \quad (2)$$

The application of this EoS to a mixture requires the selection of mixing rules for calculating its cohesive and co-volume parameters,

$a$  and  $b$ . Classical Van der Waals one-fluid mixing rules are used in the PR78 model:

$$\left\{ \begin{array}{l} a(T, z) = \sum_{i=1}^N \sum_{j=1}^N z_i z_j \sqrt{a_i(T) a_j(T)} (1 - k_{ij}(T)) \\ b(z) = \sum_{i=1}^N z_i b_i \end{array} \right. \quad (3)$$

Where  $N$  is the number of compounds in the mixture and  $\mathbf{z} = (z_1, \dots, z_N)$ , the mole fraction vector. The temperature-dependent  $k_{ij}(T)$  parameter is the so-called binary interaction parameter characterizing the molecular interactions between molecules  $i$  and  $j$ . The most accurate application of the original PR78 model requires the empirical optimization of the  $k_{ij}(T)$  parameter over, at least, vapour-liquid equilibrium experimental data.

In order to render predictive the PR78 EoS, the temperature-dependent  $k_{ij}(T)$  parameter was expressed as:

$$k_{ij}(T) = \frac{E_{ij}(T) - (\delta_i - \delta_j)^2}{2\delta_i\delta_j} \text{ with } \delta_i = \frac{\sqrt{a_i}}{b_i} \quad (4)$$

and a group contribution method was developed to predict  $E_{ij}(T)$ :

$$E_{ij}(T) = -\frac{1}{2} \left[ \sum_{k=1}^{N_g} \sum_{l=1}^{N_g} (\alpha_{ik} - \alpha_{jk})(\alpha_{il} - \alpha_{jl}) A_{kl} \left( \frac{298.15}{T/K} \right)^{\left( \frac{B_{kl}}{A_{kl}} - 1 \right)} \right] \quad (5)$$

In Eq. (4),  $a_i$  and  $b_i$  values are calculated from Eq. (2).  $A_{kl}$  and  $B_{kl}$  are the G-bips; they are constant real numbers (like the  $A_{ij}$  parameters of the UNIFAC matrix), the numerical values of which were determined by correlating thousands of fluid-phase equilibria experimental data. In addition, they are symmetric,  $A_{kl} = A_{lk}$  and  $B_{kl} = B_{lk}$  (where  $k$  and  $l$  are two different groups), and  $A_{kk} = B_{kk} = 0$ . In Eq. (5),  $N_g$  is the number of different groups defined by the method and  $\alpha_{ik}$  is the fraction of molecule  $i$  occupied by group  $k$  (occurrence of group  $k$  in molecule  $i$  divided by the total number of groups present in molecule  $i$ ). The inclusion in the PR78 equation of state of this predictive expression for  $k_{ij}$  [Eqs. (4)-(5)] results in the *Predictive-PPR78* (PPR78).

As explained by Jaubert and Privat [23], the expression for the  $k_{ij}(T)$  reported in Eq. (4) can be equivalently derived by combining the PR EoS with the well-known *EoS/g<sup>E</sup>* Huron–Vidal mixing rules [24]:

$$\left\{ \begin{array}{l} \frac{a(T,z)}{b(z)} = \sum_{i=1}^N z_i \frac{a_i(T)}{b_i} - \frac{g^E(T,z)}{C_{EoS}} \\ b(z) = \sum_{i=1}^N z_i b_i \\ C_{EoS} = \frac{\sqrt{2}}{2} \ln(1 + \sqrt{2}) \text{ for the PR EoS} \end{array} \right. \quad (6)$$

and a Van Laar type activity coefficient ( $g^E$ ) model

$$\frac{g_{VanLaar}^E(T, z)}{C_{EoS}} = \frac{1}{2} \frac{\sum_{i=1}^N \sum_{j=1}^N z_i z_j b_i b_j E_{ij}(T)}{\sum_{j=1}^N z_j b_j} \quad (7)$$

In the end, Eq. (5) can thus be seen as an equation aimed at predicting the  $E_{ij}(T)$  parameter of a Van Laar type  $g^E$  model by group-contribution.

For completeness, we also recall that a further theoretical development of the model has been derived in the year 2010, with the recognition that it is possible to rigorously deduce the  $k_{ij}$  of any EoS, knowing those of the PR EoS [25]. The group–interaction parameters ( $A_{kl}$  and  $B_{kl}$ ) initially developed for the PR EoS can be thus used to predict the  $k_{ij}$  of any other cubic EoS, including volume-translated equations [26,27], combined with any alpha function [28–30].

The final advancement of PPR78, which resulted in the so-called *Enhanced*-PPR78, concerned the improvement of its capability of calculating the enthalpy and heat capacity changes on mixing. Such a result has been obtained with the sole modification of the set of experimental data used to optimize the group-binary-interaction parameters  $A_{kl}$  and  $B_{kl}$  of the model. This dataset, which was originally composed of only vapour-liquid equilibrium data, has been extended to enthalpy and heat capacity changes-due-to-mixing data. The mathematical formulation of the *E*-PPR78 model is indeed equivalent to the PPR78 one and the two models differ uniquely in the G-bips ( $A_{kl}$  and  $B_{kl}$ ) numerical values that were optimized on different types of experimental data. The specific optimization framework of the G-bips and corresponding results are detailed in section 2.3.

## 2.2. Optimizing $A_{kl}$ and $B_{kl}$ G-bips over mixing enthalpy and mixing heat capacity in addition to VLE data

One of the main open questions which arise when optimizing EoS parameters concerns the selection of the experimental data at the base of the optimization process: what type of data should be selected in order to ensure a precise and reliable determination of phase equilibrium and derived thermodynamic properties like enthalpies and heat capacities? The answer is not straightforward because the equations of state can predict a whole set of thermodynamic properties from the same set of optimized parameters.

In the case of pure fluids, the inclusion of vaporization enthalpies and liquid heat capacities in addition to saturation pressures and liquid densities in the optimization of model parameters leads to a small increase of accuracy in predicting enthalpies and heat capacity data and to a negligible negative impact on saturation pressures and liquid densities [31,32]. In this publication, we will show that, in case of mixtures, the conclusions are totally different. Indeed, the optimization of bips over  $h^M$  and  $c_p^M$  in addition to VLE data makes it possible to drastically improve the correlation of derived properties without deteriorating the VLE data. This is the basis for the development of the *E*-PPR78 model.

To better understand such a result, we preliminarily discuss how temperature-dependent bips (like those used in the *E*-PPR78 model) do affect the calculation of mixing enthalpy, heat capacity and phase equilibrium data. As emphasized in the work of Qian et al. [15], molar enthalpy and molar heat capacity changes on mixing in a N-component mixture are straightforwardly connected to the corresponding T,v-residual properties by:

$$h^M(T, v, \mathbf{z}) = h^{res}(T, v, \mathbf{z}) - \sum_{i=1}^N z_i h_i^{res}(T, v_i) \quad (8)$$

$$c_p^M(T, v, \mathbf{z}) = c_p^{res}(T, v, \mathbf{z}) - \sum_{i=1}^N z_i c_{p,i}^{res}(T, v_i) \quad (9)$$

where  $m^{res}(T, v, \mathbf{z})$  and  $m_i^{res}(T, v_i)$  are the T,v-residual property ( $m = h$  or  $c_p$ ) of, respectively, the mixture and of the  $i$ -th pure component, which can be both calculated from an EoS;  $v_i$  denotes the molar volume of pure  $i$  at the same temperature  $T$  and pressure  $P_{mix} = P(T, v, \mathbf{z})$  as the mixture and is obtained basically from the resolution of the EoS for pure component  $i$  at fixed  $T$  and  $P_{mix}$ , i.e., by solving:  $P(T, v_i, z_i = 1) = P_{mix}$ . Note that by ‘‘T,v-residual property’’, it is here meant the departure function between the real property and the corresponding perfect-gas property having the same temperature, composition and molar volume as the real mixture. The PPR78 equation of state leads to:

$$h^{res}(T, v, \mathbf{z}) = \frac{R \cdot T \cdot b_m(\mathbf{z})}{v - b_m(\mathbf{z})} - \frac{a_m(T, \mathbf{z}) \cdot v}{v[v + b_m(\mathbf{z})] + b_m(\mathbf{z})[v - b_m(\mathbf{z})]} - \frac{1}{2\sqrt{2} \cdot b_m(\mathbf{z})} \cdot (a_m(T, \mathbf{z}) - T \cdot \frac{da_m(T, \mathbf{z})}{dT}) \cdot \ln \left[ \frac{v + (1 + \sqrt{2})b_m(\mathbf{z})}{v + (1 - \sqrt{2})b_m(\mathbf{z})} \right] \quad (10)$$

and,

$$c_p^{res}(T, v, \mathbf{z}) = c_v^{res}(T, v, \mathbf{z}) - R + T(\kappa_T \cdot v)(\beta \cdot P)^2$$

$$\text{with } \begin{cases} \kappa_T \cdot v = \left[ \frac{RT}{[v - b_m(\mathbf{z})]^2} - \frac{2 \cdot a_m(T, \mathbf{z})[v + b_m(\mathbf{z})]}{[v(v + b_m(\mathbf{z}) + b_m(\mathbf{z})(v - b_m(\mathbf{z}))])^2} \right]^{-1} \\ \beta \cdot P = \frac{R}{v - b_m(\mathbf{z})} - \frac{da_m(T, \mathbf{z})}{dT} \cdot \frac{1}{v[v + b_m(\mathbf{z})] + b_m(\mathbf{z})[v - b_m(\mathbf{z})]} \\ c_v^{res} = \frac{T}{2\sqrt{2} \cdot b_m(\mathbf{z})} \cdot \frac{d^2 a_m(T, \mathbf{z})}{dT^2} \cdot \ln \left[ \frac{v + (1 + \sqrt{2})b_m(\mathbf{z})}{v + (1 - \sqrt{2})b_m(\mathbf{z})} \right] \end{cases} \quad (11)$$

Pure component properties can be derived from equations above, considering that:

$$h_i^{res}(T, v_i) = h^{res}(T, v_i, z_i = 1) \quad (12)$$

$$c_{p,i}^{res}(T, v_i) = c_p^{res}(T, v_i, z_i = 1) \quad (13)$$

Knowing that  $a_m(T, \mathbf{z}) = \sum_{i=1}^N \sum_{j=1}^N z_i z_j \sqrt{a_i a_j} (1 - k_{ij}(T))$  (Van der Waals mixing rule for the energy parameter), the first and the second temperature derivatives of  $a_m(T, \mathbf{z})$  are:

$$\left( \frac{da_m(T, \mathbf{z})}{dT} \right)_{\mathbf{z}} \quad (14)$$

$$= \sum_{i=1}^N \sum_{j=1}^N z_i z_j \left[ [1 - k_{ij}(T)] \frac{a_j \frac{da_i}{dT} + a_i \frac{da_j}{dT}}{2\sqrt{a_i a_j}} - \sqrt{a_i a_j} \frac{dk_{ij}(T)}{dT} \right]$$

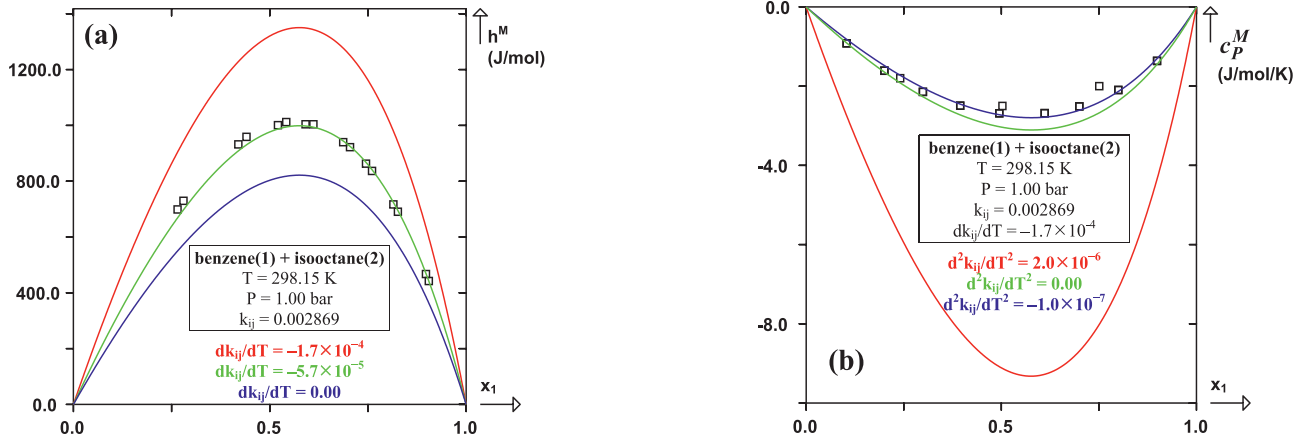
$$\left( \frac{d^2 a_m(T, \mathbf{z})}{dT^2} \right)_{\mathbf{z}} \quad (15)$$

$$= \sum_{i=1}^N \sum_{j=1}^N z_i z_j \left[ [1 - k_{ij}(T)] \left[ \frac{a_j \frac{d^2 a_i}{dT^2} + 2 \frac{da_i}{dT} \frac{da_j}{dT} + a_i \frac{d^2 a_j}{dT^2}}{2\sqrt{a_i a_j}} - \frac{(a_i \frac{da_j}{dT} + a_j \frac{da_i}{dT})^2}{4(a_i a_j)^{1.5}} \right] - \frac{dk_{ij}(T)}{dT} \frac{a_j \frac{da_i}{dT} + a_i \frac{da_j}{dT}}{\sqrt{a_i a_j}} - \sqrt{a_i a_j} \frac{d^2 k_{ij}(T)}{dT^2} \right]$$

As shown in our previous studies, temperature-dependent binary interaction parameters  $k_{ij}(T)$  play an important role in the phase equilibrium calculations. Equations (10)–(11) and (14)–(15) show the mathematical relation between the first derivative of  $k_{ij}(T)$  with temperature ( $dk_{ij}/dT$ ) and mixing enthalpy, as well as the dependence of mixing heat capacity with  $dk_{ij}/dT$  and the second derivative  $d^2 k_{ij}/dT^2$ .

In order to give an illustration of these relations, Fig. 1-a shows three calculated  $h^M - x$  curves for the system (benzene(1) + isooctane(2)) at  $T = 298.15$  K and under  $P = 1.00$  bar, with the Peng-Robinson EoS and Van der Waals mixing rules (see Eqs. (4)–(5)), together with experimental data points. The  $k_{ij}$  chosen here for the 3 curves is the value returned by the PPR78 model, that is:  $k_{ij} = 0.0029$ .  $h^M - x$  curves are calculated with three different  $dk_{ij}/dT$  values, resulting from the use of different couples of parameters  $A_{kl}$ ,  $B_{kl}$  giving the same  $k_{ij}(T)$ ; they are:  $\frac{dk_{ij}}{dT} = -1.7 \cdot 10^{-4}$  (in red),  $\frac{dk_{ij}}{dT} = -5.7 \cdot 10^{-5}$  (in green) and  $dk_{ij}/dT = 0.0$  (in blue), among which  $\frac{dk_{ij}}{dT} = -1.7 \cdot 10^{-4}$  (in red) is the value obtained from the PPR78 model, and  $\frac{dk_{ij}}{dT} = -5.7 \cdot 10^{-5}$  (in green) is the value that best describes these experimental  $h^M$  data points. Fig. 1-a emphasises that the influence of  $dk_{ij}/dT$  on  $h^M$  is very significant, despite of its small magnitude.

Similar illustration (see Fig. 1-b) and explanation apply to the influence of  $d^2 k_{ij}/dT^2$  on  $c_p^M$ . We must indicate that  $k_{ij} = 0.0029$  and  $\frac{dk_{ij}}{dT} = -1.7 \cdot 10^{-4}$  taken here are those obtained from the PPR78 model and only the influence of  $d^2 k_{ij}/dT^2$  on  $c_p^M$  has been checked (i.e., different couples of parameters  $A_{kl}$ ,  $B_{kl}$  can provide the same  $k_{ij}(T)$  and the same  $dk_{ij}/dT$  but different  $d^2 k_{ij}/dT^2$ ). It is obvious that the  $c_p^M$  values change a lot as  $d^2 k_{ij}/dT^2$  varies from



**Fig. 1.**  $h^M$ - $x$  and  $c_p^M$ - $x$  curves for the binary system: (benzene(1) + isoctane(2)) at  $T=298.15$  K and under  $P=1$  bar. (\*) experimental  $h^M$  and  $c_p^M$  points. Solid line: calculated curves. (a) Calculated  $h^M$  curves with the Peng-Robinson EoS and Van der Waals mixing rules, using  $k_{ij}=0.0029$  (PPR78) and three different  $dk_{ij}/dT$  values:  $dk_{ij}/dT = -1.7 \times 10^{-4}$  (PPR78),  $dk_{ij}/dT = -5.7 \times 10^{-5}$  (best fit) and  $dk_{ij}/dT = 0.00$ . (b) Calculated  $c_p^M$  curves with the Peng-Robinson EoS and Van der Waals mixing rules, using  $k_{ij}=0.0029$ ,  $dk_{ij}/dT = -1.7 \times 10^{-4}$  (PPR78), and three different  $d^2k_{ij}/dT^2$  values:  $d^2k_{ij}/dT^2 = 2.0 \times 10^{-6}$  (PPR78),  $d^2k_{ij}/dT^2 = 0.00$  and  $d^2k_{ij}/dT^2 = -1.0 \times 10^{-7}$  (best fit).

$-1.0 \cdot 10^{-7}$  to  $2.0 \cdot 10^{-6}$  passing through 0.0 and the value that best fits the experimental  $c_p^M$  points is:  $\frac{d^2k_{ij}}{dT^2} = -1.0 \cdot 10^{-7}$  (in blue).

The first conclusion is that, at a given temperature, there exists a broad range of couples of parameters ( $A_{kl}$ ,  $B_{kl}$ ) which allow for the determination of equal  $k_{ij}(T)$  but very different  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$ . As a direct consequence, the correlation of enthalpy (that depends on  $dk_{ij}/dT$ ) and heat capacity (that depends on both  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$ ) data at a given temperature can be thus improved without affecting the correlation of isothermal VLE data (that depends on  $k_{ij}$  only at given temperature). By analysing the sensitivity of the  $k_{ij}(T)$  function with respect to the ( $A_{kl}$ ,  $B_{kl}$ ) parameters, we observed that  $k_{ij}$  values are strongly influenced by the  $A_{kl}$  G-bips but depend weakly on  $B_{kl}$  while the influence of the  $B_{kl}$  parameters is more visible on the derived properties ( $h^M$  and  $c_p^M$ ). By overstating the point, it should be possible thus to control the  $k_{ij}$  values through the  $A_{kl}$  parameter to reproduce VLE data accurately and to control  $k_{ij}$  derivatives through the  $B_{kl}$  parameters, enabling to reproduce  $h^M$  and  $c_p^M$  data accurately. As a key conclusion, it should be possible therefore to find  $A_{kl}$  and  $B_{kl}$  parameters that lead to  $k_{ij}$ ,  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$  able to accurately and simultaneously correlate VLE data,  $h^M$  data and  $c_p^M$  data.

It follows that the optimization of  $A_{kl}$  and  $B_{kl}$  over only phase equilibrium properties (as it is for  $A_{kl}$  and  $B_{kl}$  of the original PPR78 model) allows the determination of  $A_{kl}$  and  $B_{kl}$  which optimize the value of  $k_{ij}(T)$  and not the one of  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$ . As a consequence, although the original PPR78 model offers a good prediction of binary interaction parameters (and thus of VLE data), the estimations of their first and second derivatives ( $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$ ) and thus of  $h^M$  and  $c_p^M$  data remain uncertain. This is because enthalpies and heat capacities (which depend on  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$ ) are not included in the optimization process. For this reason, it is important to re-fit  $A_{kl}$  and  $B_{kl}$  by using VLE,  $h^M$  and  $c_p^M$  data, so as to establish a group contribution aimed at accurately estimating the  $k_{ij}(T)$ ,  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$  functions.

In the following section 2.3, we will quantify how the  $A_{kl}$  and  $B_{kl}$  values, simultaneously optimized over VLE,  $h^M$  and  $c_p^M$  data, affect the accuracy of each set of properties.

### 2.3. The early optimisation of the Enhanced-PPR78 model

#### 2.3.1. Methodology

Between the years 2004 and 2013,  $A_{kl}$  and  $B_{kl}$  G-bips of the PPR78 model have been optimised for a total of 21 groups minimising the objective function depicted in Eq. (16), which includes

only phase equilibrium data of binary systems (liquid and gas phase compositions, indicated with subscripts “b” for bubble and “d” for dew, critical compositions (mole fractions  $z_c$ ) and pressures ( $P_c$ ), azeotropic compositions (mole fractions  $z_{az}$ ) and pressures ( $P_{az}$ ):

$$F_{obj,PPR78}(\%) = \frac{f_b(\%) \cdot n_b + f_d(\%) \cdot n_d + f_{z_c}(\%) \cdot n_c + f_{P_c}(\%) \cdot n_c + f_{z_{az}}(\%) \cdot n_{az} + f_{P_{az}}(\%) \cdot n_{az}}{n_b + n_d + 2n_c + 2n_{az}} \quad (16)$$

where:

$$f_b(\%) = \frac{100}{2n_b} \sum_{i=1}^{n_b} \left( \frac{|\Delta x|}{x_{1,exp}} + \frac{|\Delta x|}{x_{2,exp}} \right)_i \quad (17)$$

$$|\Delta x| = |x_{1,exp} - x_{1,cal}| = |x_{2,exp} - x_{2,cal}|$$

$$f_d(\%) = \frac{100}{2n_d} \sum_{i=1}^{n_d} \left( \frac{|\Delta y|}{y_{1,exp}} + \frac{|\Delta y|}{y_{2,exp}} \right)_i \quad (18)$$

$$|\Delta y| = |y_{1,exp} - y_{1,cal}| = |y_{2,exp} - y_{2,cal}|$$

$$f_{z_c}(\%) = \frac{100}{2n_c} \sum_{i=1}^{n_c} \left( \frac{|\Delta z_c|}{(z_c)_{1,exp}} + \frac{|\Delta z_c|}{(z_c)_{2,exp}} \right)_i \quad (19)$$

$$|\Delta z_c| = |(z_c)_{1,exp} - (z_c)_{1,cal}| = |(z_c)_{2,exp} - (z_c)_{2,cal}|$$

$$f_{P_c}(\%) = \frac{100}{n_c} \sum_{i=1}^{n_c} \left( \frac{|\Delta P_c|}{P_{c,exp}} \right)_i \quad \text{with } |\Delta P_c| = |P_{c,exp} - P_{c,cal}| \quad (20)$$

$$f_{z_{az}}(\%) = \frac{100}{2n_{az}} \sum_{i=1}^{n_{az}} \left( \frac{|\Delta z_{az}|}{(z_{az})_{1,exp}} + \frac{|\Delta z_{az}|}{(z_{az})_{2,exp}} \right)_i \quad (21)$$

$$|\Delta z_{az}| = |(z_{az})_{1,exp} - (z_{az})_{1,cal}| = |(z_{az})_{2,exp} - (z_{az})_{2,cal}|$$

$$f_{P_{az}}(\%) = \frac{100}{n_c} \sum_{i=1}^{n_{az}} \left( \frac{|\Delta P_{az}|}{P_{az,exp}} \right)_i \quad \text{with } |\Delta P_{az}| = |P_{az,exp} - P_{az,cal}| \quad (22)$$

During his Ph.D. thesis, the 210  $A_{kl}$  and 210  $B_{kl}$  G-bips of the PPR78 model have been re-optimised by Qian [16] by minimising the objective function given by Eq. (23), which also includes mixing properties (enthalpy and heat capacity). A totally new set of G-bips ( $A_{kl}$  and  $B_{kl}$ ) was thus obtained and the E-PPR78 model was born.

$$f_{obj,E-PPR78}(\%) = \frac{f_b(\%) \cdot n_b + f_d(\%) \cdot n_d + f_z(\%) \cdot n_z + f_l(\%) \cdot n_l + f_{z_c}(\%) \cdot n_{z_c} + f_{az}(\%) \cdot n_{az} + f_{r_c}(\%) \cdot n_{r_c} + f_{h^M}(\%) \cdot n_{h^M} + f_{c_p^M}(\%) \cdot n_{c_p^M}}{n_b + n_d + 2n_z + 2n_{az} + n_{h^M} + n_{c_p^M}} \quad (23)$$

where:

$$f_{h^M}(\%) = \frac{100}{n_{h^M}} \sum_{i=1}^{n_{h^M}} \left( \frac{\Delta h_i^M}{h_{exp}^M} \right) \quad \text{with } \Delta h_i^M = |h_{exp}^M - h_{cal}^M| \quad (24)$$

$$f_{c_p^M}(\%) = \frac{100}{n_{c_p^M}} \sum_{i=1}^{n_{c_p^M}} \left( \frac{\Delta c_{p,i}^M}{c_{p,exp}^M} \right) \quad \text{with } \Delta c_{p,i}^M = |c_{p,exp}^M - c_{p,cal}^M| \quad (25)$$

The pure fluid physical properties ( $T_c$ ,  $P_c$  and  $\omega$ ) used in the optimization originate from two sources. It has been made reference to Poling et al. [33] for alkanes, aromatics, naphthenes, alkenes, CO<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>S, H<sub>2</sub> and H<sub>2</sub>O. Moreover, as some mercaptans and alkenes were missing in Poling’s book, the DIPPR database was chosen instead. As recently discussed by Chiko and Polishuk [34], the disagreements between ( $T_c$ ,  $P_c$  and  $\omega$ ) from different sources, which may exist for very heavy compounds, may substantially influence the results of PPR78. This is because the critical pressures of very heavy components are very small so that a slight absolute difference between two values (let us say 0.5 bar) may lead to an important relative difference (around 10%). In the cases of compounds absent in both the book of Poling et al. and DIPPR, the only solution is to estimate the critical properties from a group-contribution method and the reader has to be aware that its accuracy on the estimated  $P_c$  can significantly affect the results. The list of the pure fluids considered to develop the E-PPR78 model can be found in Table S1 of the Supporting Information.

The fluid-phase-equilibrium data used at the basis of the optimization process of PPR78 are reported in publications [1–5,7–12]. All bibliographic sources of data used to optimize E-PPR78 model (including its extension to 40 groups) can be either found in Qian’s thesis [16] or in some of our previous publications [17–21]; they are also reported in Table S3 of the Supporting Information and at the end of this paper. In order to quantify the accuracy with which the  $h^M$  and  $c_p^M$  data are correlated, we also defined the error function on  $h^M$  and  $c_p^M$  data ( $f_{h^M+c_p^M}(\%)$ ) as:

$$f_{h^M+c_p^M}(\%) = \frac{f_{h^M}(\%) \cdot n_{h^M} + f_{c_p^M}(\%) \cdot n_{c_p^M}}{n_{h^M} + n_{c_p^M}} \quad (26)$$

Similarly, the error function on VLE data only, noted  $f_{VLE}(\%)$  in Table 1 is expressed by Eq. (16) and the overall calculated error function on  $h^M$ ,  $c_p^M$  and VLE data, noted  $f_{tot}(\%)$  in Table 1 is given by Eq. (23).

### 2.3.2. Results

In order to show a comparison between the PPR78 and E-PPR78 EoS versions and thus to demonstrate the gain in accuracy underlying the introduction of mixing enthalpies and heat capacities in the optimization process, Table 1 presents the error functions presented in equations (16)–(26) obtained by the application of the PPR78 and E-PPR78 models to the binary data used to optimise the  $A_{kl}$  and  $B_{kl}$  G-bips relative to 21 first groups that allow to define 10 classes of molecules: Alkanes (groups: G1–G6), Aromatics (groups: G7–G9), Naphthenes (groups: G10–G11), CO<sub>2</sub> (group G12), N<sub>2</sub> (group G13), H<sub>2</sub>S (group G14), Mercaptans (group G15), H<sub>2</sub>O (group G16), Alkenes (groups G17–G20), H<sub>2</sub> (group G21).

It is specified that the optimal  $A_{kl}$  and  $B_{kl}$  G-bips suitable for the E-PPR78 model and determined according to the optimisation method presented in section 2.3.1 (minimization of Eq. (23)) are reported in Table S4 of the Supporting Information. Such parameters coincide with the ones published in our previous papers devoted to the E-PPR78 model [17–21]. We however decided to take advantage of the publication of this article to partially complete the G-bips matrix given in Table S4. We indeed found enough experimental data to determine the missing interactions between 3

pairs of groups: [G12(CO<sub>2</sub>) and G15(–SH)], [G13(N<sub>2</sub>) and G15(SH)] and [G3(CH<sub>alkanes</sub>) and G20(CH<sub>cycloalkenic</sub>/–C<sub>cycloalkenic</sub>)].

For each considered type of VLE data reported in Table 1 (for example, liquid phase composition data), we present in the same table: 1) the total number of considered experimental data points ( $n_{datapoints}$ ) and 2) the number of data (for liquid phase composition:  $n_b$ ) for which a deviation between calculated and experimental value could be calculated, i.e., that results to be not-“out-of-model” from the application of the original or enhanced version of the PPR78 model (for liquid phase composition:  $n_b$  PPR78 and  $n_b$  E-PPR78). To fix the ideas and understand in which occasion an experimental data point is declared “out of model” (i.e., not calculable by the model), let us take an example by considering a model which does not predict the existence of a homogeneous azeotrope that is however experimentally observed. In such a case, the deviations between calculated and experimental azeotropic pressure and composition cannot be evaluated and the corresponding experimental data point is said to be “out of model” (for more examples, the reader is referred to [35–37]).

To simplify the comparison between the PPR78 and E-PPR78 models, Figs. 2 and 3 graphically show the error functions on VLE (Eq. (16)) and mixing properties functions (Eq. (26)) reported in Table 1.

### 2.3.3. Analysis

Numerical results reported in the previous section reveal how the accuracy of the model on VLE calculations and on mixing properties evolves when including mixing properties in the optimization process. In spite of the simultaneous correlation of VLE,  $h^M$  and  $c_p^M$  data during the development of the E-PPR78 model, the error function over all the VLE data (10 families of molecules) with such a model ( $f_{VLE,E-PPR78} = 8.77\%$ ) is exactly the same (less than 0.2% difference) than that obtained with the original PPR78 model ( $f_{VLE,PPR78} = 8.62\%$ ) where only VLE data were considered for model optimisation. In other words, the inclusion of  $h^M$  and  $c_p^M$  data in addition to fluid-phase equilibrium data during the optimisation of the G-bips does not deteriorate the accuracy in predicting VLE properties. This is an extremely significant and not-easily anticipable result. Another key result requires discussion: although the accuracy on VLE data remains the same, the inclusion of  $h^M$  and  $c_p^M$  in the optimization process makes drastically decrease the deviations on both mixing properties data. Table 1 shows that the error functions on  $h^M$  and  $c_p^M$  (Eqs. (24)–(25)) are remarkably improved; they are divided by a factor 11 and 55 respectively. We can thus conclude to the absolute necessity to include  $h^M$  and  $c_p^M$  data in the fitting procedure if we want to catch, in addition to VLE data, such properties with the PR EoS. Such results confirm our insight regarding the role and influence of the  $A_{kl}$  and  $B_{kl}$  parameters on the reproduction of VLE and energetic property data, respectively (see section 2.2)

The major achievements occur for  $h^M$  data points in the liquid single-phase region and for all  $c_p^M$  data points (available only in the liquid single-phase region). The improvements in  $h^M$  in the gaseous single-phase region and those referring to the two-phase region are less significant since such data were already accurately correlated by the PPR78 model.

Although the simultaneous inclusion of  $h^M$ ,  $c_p^M$  and VLE data has been carried out during the fitting procedure aimed at determining the G-bips of the E-PPR78 model, the error functions on  $h^M$  and  $c_p^M$  are still much higher than that of VLE, which can be explained by the reasons as follows:

- (1) The set of experimental  $h^M$  and  $c_p^M$  data reported in the literatures are sometimes discordant and scattered.
- (2) Many liquid mixtures (especially those that contain H<sub>2</sub>) slightly deviate from an ideal behaviour so that calculated

**Table 1**  
Error functions by class of compounds obtained with PPR78 model and E-PPR78 model. A total of 135,186 data points from 1051 binary systems were considered.

Type of data		Alkanes (G1-G6)	Aromatics (G7-G9)	Naphthenes (G10-G11)	CO <sub>2</sub> (G12)	N <sub>2</sub> (G13)	H <sub>2</sub> S (G14)	Mercaptans (G15)	H <sub>2</sub> O (G16)	Alkenes (G17-G20)	H <sub>2</sub> (G21)	Total (G1-G21)
Liquid phase composition	$n_{datapoints}$	9205	6883	5051	8956	4362	2351	775	4986	9123	5534	57226
	$n_b$ PPR78	9084	6700	4902	8661	4305	2220	751	4693	8924	5517	55757
	$n_b$ E-PPR78	9094	6701	4905	8641	4296	2231	753	4677	8911	5514	55723
	$f_b$ PPR78 (%), eq. (17)	3.77	5.99	3.92	7.46	9.80	10.20	9.93	28.28	8.95	8.68	8.81
	$f_b$ E-PPR78 (%), eq. (17)	4.00	6.23	4.10	7.85	9.74	10.01	10.76	28.34	9.30	8.83	9.02
Gas phase composition	$n_{datapoints}$	6995	4864	3438	7268	4680	1651	364	3875	6268	3905	43308
	$n_d$ PPR78	6894	4752	3309	6785	4631	1558	339	3437	6048	3835	41588
	$n_d$ E-PPR78	6898	4753	3314	6752	4630	1562	345	3431	6033	3833	41551
	$f_d$ PPR78 (%), eq. (18)	5.94	6.35	4.53	8.72	7.23	7.71	8.37	16.48	10.83	10.30	8.54
	$f_d$ E-PPR78 (%), eq. (18)	5.94	6.51	4.63	8.65	7.30	7.71	9.51	16.52	11.19	10.29	8.63
Critical point composition	$n_{datapoints}$	159	146	347	274	97	67	0	159	143	114	1506
	$n_c$ PPR78	159	146	345	263	97	62	0	99	142	104	1417
	$n_c$ E-PPR78	158	146	347	262	96	62	0	100	142	103	1416
	$f_{zc}$ PPR78 (%), eq. (19)	5.99	6.53	2.84	7.44	8.99	8.92	0.00	18.88	10.29	5.95	7.21
	$f_{zc}$ E-PPR78 (%), eq. (19)	6.17	5.00	4.42	6.75	8.94	9.49	0.00	18.49	10.84	5.83	7.37
Critical point pressure	$n_{datapoints}$	159	146	347	274	97	67	0	159	143	114	1506
	$n_c$ PPR78	159	146	345	263	97	62	0	99	142	104	1417
	$n_c$ E-PPR78	158	146	347	262	96	62	0	100	142	103	1416
	$f_{pc}$ PPR78 (%), eq. (20)	4.18	4.97	1.51	3.28	6.33	3.02	0.00	21.33	3.49	10.11	5.11
	$f_{pc}$ E-PPR78(%), eq. (20)	4.05	4.26	1.59	3.21	5.66	3.72	0.00	21.32	3.39	9.30	4.94
Azeotropic point composition	$n_{datapoints}$	0	0	0	0	0	0	58	0	0	0	58
	$n_{az}$ PPR78	0	0	0	0	0	0	51	0	0	0	51
	$n_{az}$ E-PPR78	0	0	0	0	0	0	52	0	0	0	52
	$f_{zaz}$ PPR78 (%), eq. (21)	0.00	0.00	0.00	0.00	0.00	0.00	20.80	0.00	0.00	0.00	20.80
	$f_{zaz}$ E-PPR78 (%), eq. (21)	0.00	0.00	0.00	0.00	0.00	0.00	13.45	0.00	0.00	0.00	13.45
Azeotropic point pressure	$n_{datapoints}$	0	0	0	0	0	0	58	0	0	0	58
	$n_{az}$ PPR78	0	0	0	0	0	0	51	0	0	0	51
	$n_{az}$ E-PPR78	0	0	0	0	0	0	52	0	0	0	52
	$f_{paz}$ PPR78 (%), eq. (22)	0.00	0.00	0.00	0.00	0.00	0.00	2.02	0.00	0.00	0.00	2.02
	$f_{paz}$ E-PPR78 (%), eq. (22)	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00	0.00	0.00	1.16
All VLE data	$n_{datapoints}$	16518	12039	9183	16772	9236	4136	1255	9179	15677	9667	103662
	$n_{VLE}$ PPR78	16296	11744	8901	15972	9130	3902	1192	8328	15256	9560	100281
	$n_{VLE}$ E-PPR78	16308	11746	8913	15917	9118	3917	1202	8308	15228	9553	100210
	$f_{VLE}$ PPR78 (%), eq. (16)	4.71	6.13	4.01	7.93	8.45	9.07	9.61	23.21	9.66	9.31	<b>8.62</b>
	$f_{VLE}$ E-PPR78 (%), eq. (16)	4.84	6.30	4.21	8.10	8.45	8.99	10.10	23.26	10.01	9.39	<b>8.77</b>
Mixing enthalpy	$n_{datapoints}$	3405	5544	8368	4952	900	39	246	1631	3621	567	29273
	$f_h^M$ PPR78 (%), eq. (24)	628.7	86.3	1481.6	65.2	13.5	56.4	362.5	81.4	235.2	21.4	561.6
	$f_h^M$ E-PPR78(%), eq. (24)	48.8	34.2	65.0	45.8	11.6	54.3	27.5	81.4	40.0	21.4	49.0
Mixing heat capacity	$n_{datapoints}$	312	869	1070	0	0	0	0	0	0	0	2251
	$f_{c_p}^M$ PPR78 (%), eq. (25)	327.75	3115.04	6802.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4481.44
	$f_{c_p}^M$ E-PPR78 (%), eq. (25)	25.73	133.83	56.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.24
All mixing properties	$n_{datapoints}$	3717	6413	9438	4952	900	39	246	1631	3621	567	31524
	$f_h^M + C_p^M$ PPR78 (%), eq.(26)	603.44	496.69	2084.79	65.24	13.47	56.42	362.50	81.40	235.19	21.40	<b>841.51</b>
	$f_h^M + C_p^M$ E-PPR78 (%), eq.(26)	46.84	47.70	64.10	45.78	11.60	54.28	27.54	81.37	40.03	21.40	<b>51.42</b>
All data	$n_{datapoints}$	20235	18452	18621	21724	10136	4175	1501	10810	19298	10234	135186
	$n_{tot}$ PPR78	20013	18157	18339	20924	10030	3941	1438	9959	18877	10127	131805
	$n_{tot}$ E-PPR78	20025	18159	18351	20869	10018	3956	1448	9939	18849	10120	131734
	$f_{tot}$ PPR78 (%), eq. (23)	<b>115.92</b>	<b>179.40</b>	<b>1074.86</b>	<b>21.49</b>	<b>8.90</b>	<b>9.54</b>	<b>69.98</b>	<b>32.74</b>	<b>52.92</b>	<b>9.99</b>	<b>207.83</b>
	$f_{tot}$ E-PPR78 (%), eq. (23)	<b>12.63</b>	<b>20.92</b>	<b>35.01</b>	<b>17.04</b>	<b>8.73</b>	<b>9.44</b>	<b>13.06</b>	<b>32.79</b>	<b>15.77</b>	<b>10.06</b>	<b>18.98</b>

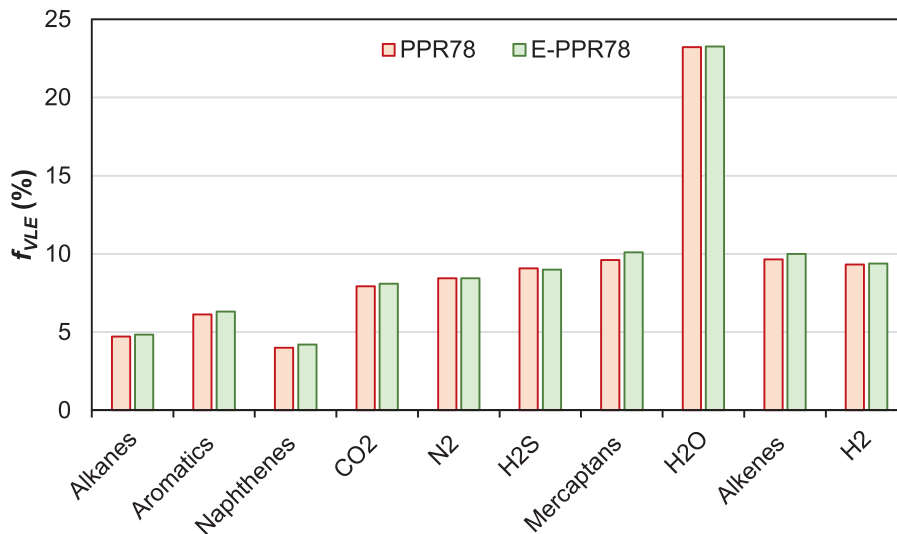


Fig. 2. Histograms of error functions on VLE data, for each of the 10 considered classes of molecules, for the PPR78 and the E-PPR78 model.

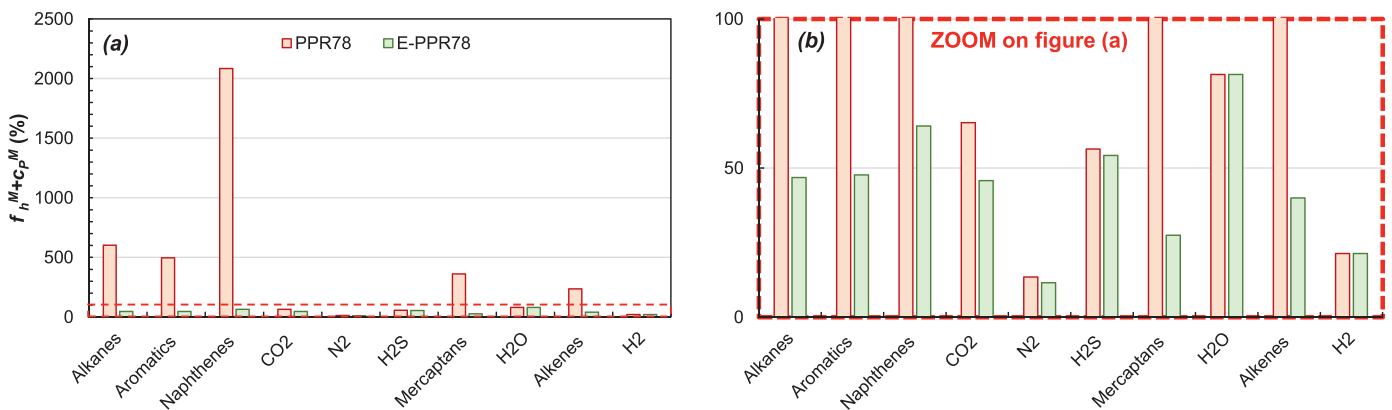


Fig. 3. Histograms of overall error functions on mixing enthalpy and heat capacity data, for each of the 10 considered classes of molecules, for the PPR78 and the E-PPR78 model. Fig. (b) is the zoom of the part of Fig. (a) in a dotted red square.

and experimental values of  $h^M$  and  $c_p^M$  are close to zero. Due to the definition of relative errors functions on  $h^M$  and  $c_p^M$  where absolute errors are standardized by experimental values (see Eqs. (24)-(25)), such small magnitudes inevitably increase these error functions.

- (3) Binary systems in the gaseous single-phase region at low temperature and under one atmosphere show small endothermic mixing effect which is not easy to be well predicted by the PR EoS.

Considering that 1051 different binary mixtures have been investigated for the definition of 21 groups and determination of 420 G-bips (210  $A_{kl}$  and 210  $B_{kl}$ ) for both the PPR78 and the E-PPR78 models, we present only some examples to illustrate the modification of model accuracy when including  $h^M$  and  $c_p^M$  data in the optimization process. Taking for example the binary mixture benzene (1) + isooctane (2), we plotted in Fig. 4 the predictions of VLE,  $h^M$  and  $c_p^M$ , returned by the original PPR78 model (dashed line) and its enhanced version E-PPR78 (solid line). As expected, with E-PPR78, the accuracy of predicted  $P - xy$  curves at six different temperatures is retained (Fig. 4-a) and the predicted  $h^M - x$  and  $c_p^M - x$  curves in the liquid single-phase region are in much better agreement with experimental data (see Fig. 4-b,c). Fig. 4.d shows that in the temperature range where experimental data are available (be-

tween 298 and 348 K), the PPR78 and E-PPR78 models return similar  $k_{ij}$  values so that the 2 models correlate with the same accuracy the VLE data. At the same time, the slopes of the curves  $k_{ij}$  vs.  $T$  are totally different. A much steeper curve is obtained with PPR78 in comparison to E-PPR78 so that  $dk_{ij}/dT$  take strongly different values with both models explaining why the  $h^M$  values returned by the 2 models are so different. Fig. 4.e highlights that the slopes of the curves  $dk_{ij}/dT$  vs.  $T$  calculated with the 2 models are even much different than those of the curves  $k_{ij}$  vs.  $T$ . The immediate consequence is the calculation of totally different  $d^2k_{ij}/dT^2$  values by both models leading to a huge difference in the  $c_p^M$  values returned by both models.

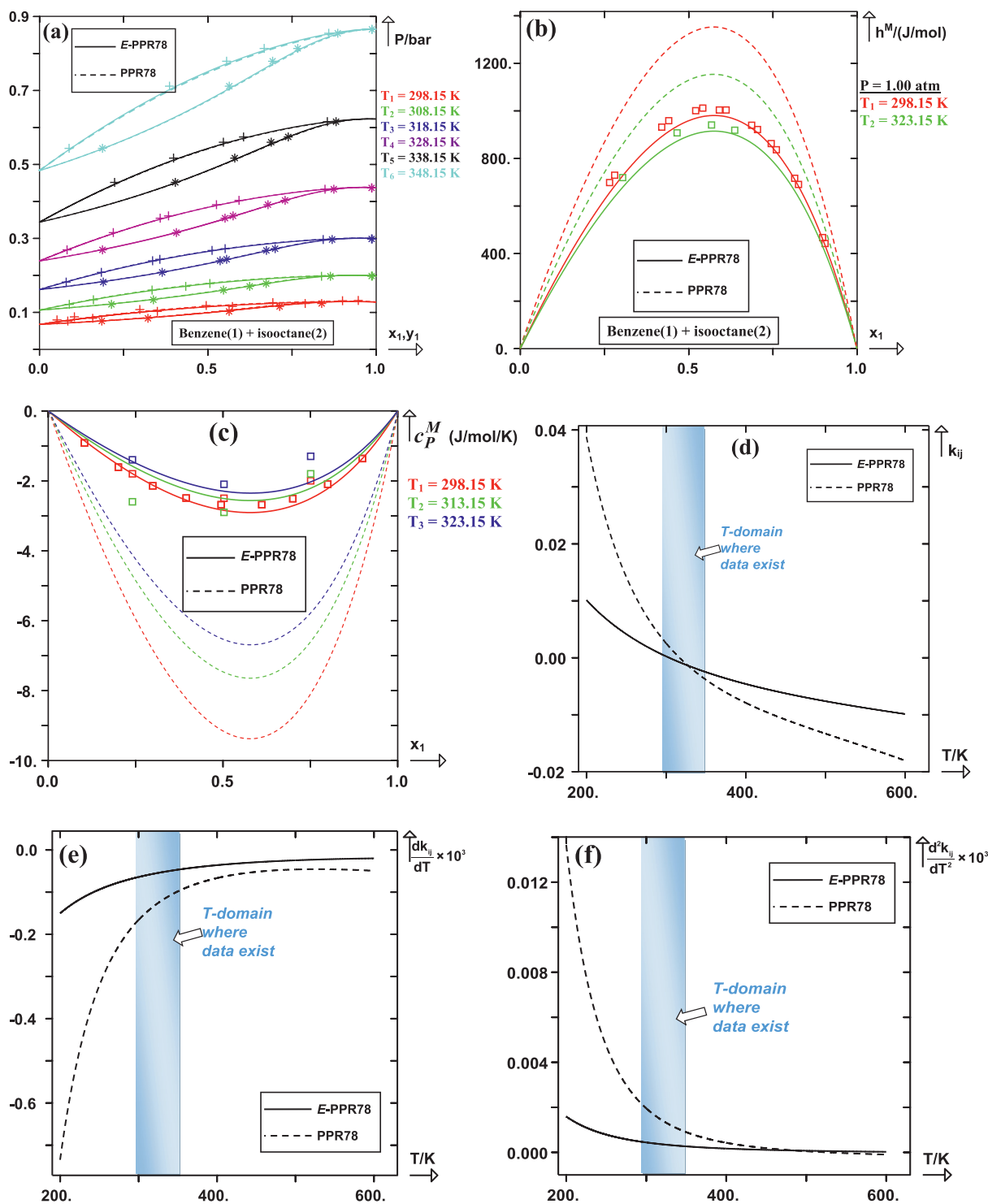
After our examination over all the mixtures, we have found that by using the parameters ( $A_{kl}$ ,  $B_{kl}$ ) determined for the E-PPR78 model, both  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$  for most of the binary mixtures at low and moderate temperatures become less temperature-dependent showing a magnitude less significant, as observed for the (benzene (1) + isooctane (2)) system. Counter examples can however be found.

The key conclusion of this paper is that the E-PPR78 model can give a better estimation of the  $dk_{ij}/dT$  and  $d^2k_{ij}/dT^2$  functions than the original PPR78 model explaining why better predictions of  $h^M$  and  $c_p^M$  are obtained. The good prediction of VLE data is retained because the  $k_{ij}$  values returned by both models are similar.



**Table 2**  
Error functions by class of compounds obtained with E-PPR78.

Type of data		Alkanes (G1-G6)	Aromatics (G7-G9)	Naph- thenes (G10- G11)	CO <sub>2</sub> (G12)	N <sub>2</sub> (G13)	H <sub>2</sub> S (G14)	Mercaptans (G15)	H <sub>2</sub> O (G16)	Alkenes (G17-G20)	H <sub>2</sub> (G21)	Freons (G22- G27)	CO (G28)	He (G29)	Ar (G30)	SO <sub>2</sub> (G31)	O <sub>2</sub> (G32)	NO (G33)	COS (G34)	NH <sub>3</sub> (G35)	NO <sub>2</sub> (G36)	N <sub>2</sub> O (G37)	Alkynes (G38- G40)	Total (G1- G40)
Liquid phase comp.	$n_{datapoints}$	9205	6883	5051	8956	4362	2351	775	4986	9123	5534	2214	1831	2599	2434	468	1770	157	184	2035	76	314	1015	72323
	$n_b$	9094	6701	4905	8641	4296	2231	753	4677	8911	5514	1993	1807	2327	2331	467	1713	157	180	1971	76	309	966	70020
	$f_b$ (%)	4.00	6.23	4.10	7.85	9.74	10.01	10.76	28.34	9.30	8.83	11.52	8.95	12.30	9.82	8.97	6.76	12.57	12.29	5.40	2.27	9.23	8.82	9.07
Gas phase comp.	$n_{datapoints}$	6995	4864	3438	7268	4680	1651	364	3875	6268	3905	1939	1408	2662	1838	287	1402	140	22	1405	1	364	428	55204
	$n_d$	6898	4753	3314	6752	4630	1562	345	3431	6033	3833	1766	1350	2369	1730	272	1343	137	22	1354	1	359	418	52672
	$f_d$ (%)	5.94	6.51	4.63	8.65	7.30	7.71	9.51	16.52	11.19	10.29	6.77	9.26	13.66	12.27	10.01	5.82	7.26	2.68	10.93	27.95	6.25	7.97	8.89
Critical point comp.	$n_{datapoints}$	159	146	347	274	97	67	0	159	143	114	92	34	31	23	6	8	2	8	16	0	20	4	1750
	$n_c$	158	146	347	262	96	62	0	100	142	103	88	34	23	17	5	8	2	8	11	0	20	4	1636
	$f_c$ (%)	6.17	5.00	4.42	6.75	8.94	9.49	0.00	18.49	10.84	5.83	16.77	19.50	21.70	112.96	1.44	8.85	10.33	15.86	14.51	0.00	16.34	2.10	9.61
Critical point pressure	$n_{datapoints}$	159	146	347	274	97	67	0	159	143	114	92	34	31	23	6	8	2	8	16	0	20	4	1750
	$n_c$	158	146	347	262	96	62	0	100	142	103	88	34	23	17	5	8	2	8	11	0	20	4	1636
	$f_{p_c}$ (%)	4.05	4.26	1.59	3.21	5.66	3.72	0.00	21.32	3.39	9.30	3.19	10.84	43.26	63.59	7.04	7.45	33.01	2.03	9.02	0.00	6.94	0.44	6.20
Azeotropic point comp.	$n_{datapoints}$	0	0	0	0	0	0	58	0	0	0	0	0	0	0	20	0	0	4	0	0	0	8	90
	$n_{az}$	0	0	0	0	0	0	52	0	0	0	0	0	0	0	20	0	0	4	0	0	0	8	84
	$f_{z_{az}}$ (%)	0.00	0.00	0.00	0.00	0.00	0.00	13.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.34	0.00	0.00	5.36	0.00	0.00	0.00	8.07	13.00
Azeotropic point pressure	$n_{datapoints}$	0	0	0	0	0	0	58	0	0	0	0	0	0	0	20	0	0	4	0	0	0	8	90
	$n_{az}$	0	0	0	0	0	0	52	0	0	0	0	0	0	0	20	0	0	4	0	0	0	8	84
	$f_{p_{az}}$ (%)	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.23	0.00	0.00	0.96	0.00	0.00	0.00	2.47	2.96
<b>All VLE data</b>	$n_{datapoints}$	16518	12039	9183	16772	9236	4136	1255	9179	15677	9667	4337	3307	5323	4318	807	3188	301	230	3472	77	718	1467	131207
	$n_{VLE}$	16308	11746	8913	15917	9118	3917	1202	8308	15228	9553	3935	3225	4742	4095	789	3072	298	226	3347	77	708	1408	126132
	$f_{VLE}$ (%)	<b>4.84</b>	<b>6.30</b>	<b>4.21</b>	<b>8.10</b>	<b>8.45</b>	<b>8.99</b>	<b>10.10</b>	<b>23.26</b>	<b>10.01</b>	<b>9.39</b>	<b>9.32</b>	<b>9.21</b>	<b>13.17</b>	<b>11.51</b>	<b>9.41</b>	<b>6.35</b>	<b>10.25</b>	<b>10.80</b>	<b>7.68</b>	<b>2.60</b>	<b>7.86</b>	<b>8.49</b>	<b>8.97</b>
Mixing enthalpies	$n_{datapoints}$	3405	5544	8368	4952	900	39	246	1631	3621	567	0	44	1	878	0	56	0	0	252	0	104	770	31378
	$f_{H_M}$ (%)	48.77	34.20	65.03	45.78	11.60	54.28	246	81.37	40.03	21.40	0.00	9.21	7.97	45.67	0.00	11.74	0.00	0.00	27.21	0.00	104.95	23.38	48.21
	$\Delta T_H$ (K)	<b>0.171</b>	<b>0.205</b>	<b>0.193</b>	<b>1.075</b>	<b>0.775</b>	<b>1.265</b>	<b>0.183</b>	<b>6.540</b>	<b>0.293</b>	<b>2.060</b>	<b>0.000</b>	<b>0.081</b>	<b>0.032</b>	<b>2.042</b>	<b>0.000</b>	<b>0.114</b>	<b>0.000</b>	<b>0.000</b>	<b>1.858</b>	<b>0.000</b>	<b>0.284</b>	<b>0.41</b>	<b>0.795</b>
Mixing heat capacities	$n_{datapoints}$	312	869	1070	0	0	0	27.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2251
	$f_{c_p^M}$ (%)	25.73	133.83	56.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.24
	$n_{datapoints}$	3717	6413	9438	4952	900	39	0	1631	3621	567	0	44	1	878	0	56	0	0	252	0	104	770	33629
<b>All mixing properties</b>	$f_{H_M+c_p^M}$ (%)	<b>46.84</b>	<b>47.70</b>	<b>64.10</b>	<b>45.78</b>	<b>11.60</b>	<b>54.28</b>	0.00	<b>81.37</b>	<b>40.03</b>	<b>21.40</b>	0.00	<b>9.21</b>	<b>7.97</b>	<b>45.67</b>	0.00	<b>11.74</b>	0.00	0.00	<b>27.21</b>	0.00	<b>104.95</b>	<b>23.38</b>	<b>50.49</b>
<b>All data</b>	$n_{datapoints}$	20235	18452	18621	21724	10136	4175	1501	10810	19298	10234	4337	3351	5324	5196	807	3244	301	230	3724	77	822	2237	164836
	$n_{tot}$	20025	18159	18351	20869	10018	3956	1448	9939	18849	10120	3935	3269	4743	4973	789	3128	298	226	3599	77	812	2178	159761
	$f_{tot}$ (%)	<b>12.63</b>	<b>20.92</b>	<b>35.01</b>	<b>17.04</b>	<b>8.73</b>	<b>9.44</b>	<b>13.06</b>	<b>32.79</b>	<b>15.77</b>	<b>10.06</b>	<b>9.32</b>	<b>9.21</b>	<b>13.17</b>	<b>17.54</b>	<b>9.41</b>	<b>6.45</b>	<b>10.25</b>	<b>10.80</b>	<b>9.05</b>	<b>2.60</b>	<b>20.29</b>	<b>13.75</b>	<b>17.71</b>



**Fig. 4.** Prediction of P-xy,  $h^M$ -x,  $c_p^M$ -x,  $k_{ij}$ -T,  $dk_{ij}/dT$ -T and  $d^2k_{ij}/dT^2$ -T curves for the binary system: (benzene(1) + isooctane(2)). (+) experimental bubble points, (\*) experimental dew points, ( $\square$ ) experimental  $h^M$  and  $c_p^M$  points. Solid line: predicted curves with the E-PPR78 model. Dashed line: predicted curves with the original PPR78 model. (a) Predicted P-xy curves at six different temperatures:  $T_1 = 298.15$  K,  $T_2 = 308.15$  K,  $T_3 = 318.15$  K,  $T_4 = 328.15$  K,  $T_5 = 338.15$  K,  $T_6 = 348.15$  K. (b) Predicted  $h^M$ -x curves at two different temperatures:  $T_1 = 298.15$  K,  $T_2 = 323.15$  K. (c) Predicted  $c_p^M$ -x curves at three different temperatures:  $T_1 = 298.15$  K,  $T_2 = 313.15$  K,  $T_3 = 323.15$  K. (d)  $k_{ij}$ -T curves calculated with the recent model and the original one. (e)  $dk_{ij}/dT$ -T curves calculated with the recent model and the original one. (f)  $d^2k_{ij}/dT^2$ -T curves calculated with the recent model and the original one.

#### 2.4. The 40-GC-E-PPR78

Considering the positive results obtained when optimising the G-bips for 21 groups over, simultaneously, phase equilibrium, mixing enthalpies and heat capacities data, the E-PPR78 model has

been furthermore developed by optimising G-bips for 19 more groups. The objective function which has been considered in the optimisation process is eq. (23) and the corresponding  $A_{kl}$  and  $B_{kl}$  G-bips are reported in Table S4 of the Supporting Information.

Table S1 in the Supporting Information presents the list of the 204 pure components involved in the development of the *E*-PPR78 model. For each binary system considered in the development of the *E*-PPR78 model, Table S2 contains the main features of collected experimental data, extracted from references [38–2068]. Bibliographic references are reported in Table S3.

Table 2 reports the values of the error functions stemming from equations (16)–(26), resulting from the application of the *E*-PPR78 model to all the binary systems used in the optimisation of the different G-bips between groups G1–G40. As expected, aqueous systems show the highest relative errors on VLE data while mixtures of hydrocarbons show lowest deviations. To provide a more explicit quantification of the deviations on mixing enthalpies, we also provide in Table 2 the average value of the temperature deviation ( $\Delta T_h$ ) corresponding to a deviation in mixing enthalpy:

$$\Delta T_h = \frac{1}{n_{hM}} \sum_{i=1}^{n_{hM}} \Delta T_i \text{ with } \Delta T_i = |h_{exp}^M - h_{cal}^M|/c_p \quad (27)$$

where  $c_p$  is the molar heat capacity of the binary mixture,  $\Delta T_i$  is the temperature change for one experimental enthalpy data point. Indeed, as discussed in a previous publication [15],  $f_{hM}(\%)$  and  $\Delta T_h$  criteria « are strictly non-equivalent to discuss the capacity of a model to predict mixing enthalpy data. [...] the  $\Delta T_h$  criterion is definitively preferred because it provides a fair overview on the model accuracy to perform an energy balance. » Indeed, as mentioned in section 2.3.3 relative error function ( $f_{hM}(\%)$ ) can be very high when enthalpies of mixing are very small, although the corresponding temperature change of the fluid ( $\Delta T_h$ ) due to such an error is very small.

Table S5 – Table S8 of the supporting information show the deviations between calculated and experimental data calculated with the *E*-PPR78 model on all types of data points following a further organisation of binary systems: error functions are reported grouping binary systems according to the type of each molecule of the mixture considered in the development of this model. Ten types of molecules are considered: alkanes, alkenes, alkynes, aromatics, naphthenes, freons, sulfur-containing compounds (mercaptans,  $H_2S$ ,  $SO_2$ ,  $COS$ ), non-permanent gases ( $NH_3$ ,  $CO_2$ ,  $C_2H_6$ ,  $C_2H_4$ ,  $C_2H_2$ ,  $NO$ ,  $NO_2$ ,  $N_2O$ ), permanent gases ( $N_2$ ,  $Ar$ ,  $O_2$ ,  $CO$ ,  $He$ ,  $CH_4$ ,  $H_2$ ), water.

The analysis of Table S5 – Table S8 shows that the highest deviations on VLE data are due to the presence of either water or aromatics in the mixture. As regards aromatics, this statement is valid for mixtures of aromatics and non-hydrocarbons. Also, it is possible to confirm the more reliable assessment of temperature deviations (Eq. (27)) due to inaccuracies on mixing enthalpies, rather than relative error function on mixing enthalpies (Eq. (24)), to evaluate the suitability of a model in accurately modelling energy balances. Indeed, naphthenes-naphthenes systems are characterized by an error function on mixing enthalpy equal to 276.50 % (very high) and  $\Delta T_h = 0.136$  K (very low), while the opposite conclusion is for aromatics-water, for which the error function on mixing enthalpy is equal to 45.48 % (quite low) and  $\Delta T_h = 10.097$  K (extremely high). The temperature deviation criterion is the one that better represents the quality and the accuracy of the model when applied to perform energy balances. These tables provide to the reader interested in using the *E*-PPR78 EoS a closer view on the errors made by the model in representing the data of binary systems.

### 3. Conclusion

This paper has shown the impact of including change-on-mixing derived property data (mixing enthalpies and mixing heat capacities) other than classically used VLE data, when optimising thermodynamic models. The key conclusion is that the inclusion of

such data in such an optimisation methodology enables a significant improvement of mixing property prediction without deteriorating the accuracy in predicting VLE properties. Ten years ago, this observation led some of the authors of this paper to think about modifying the methodology at the basis of the development of the PPR78 EoS for identifying optimal bips between groups. This idea has led to the development of a model which is known today as *Enhanced*-PPR78 (*E*-PPR78). This paper explicitly invites model developers to consider mixing enthalpies and mixing heat capacities when parameterizing an EoS.

Finally, a complete overview on the accuracy of the state-of-the-art *E*-PPR78 model, based on 40 groups, is provided. Considering the predictive character of this model, the deviations are acceptably low for all the systems, except for water-hydrocarbons mixtures. Finally, this paper presents three never published ( $A_{kl}$ ,  $B_{kl}$ )-couples of G-bips, between group 12 ( $CO_2$ ) and group 15 (-SH), group 13 ( $N_2$ ) and group 15 (-SH), group 3 (- $CH_{alkanes}$ ) and group 20 (- $CH_{cycloalkenic}/-C_{cycloalkenic}$ ).

Eventually, it can be mentioned that these thoughts about EoS parameter estimation are taking part in a series of recent research works performed by our group and dealing with the general issue of parameterization [2069,2070] and accuracy assessment [2071] of cubic and SAFT EoS. In particular, regarding cubic models, proof was given that alpha functions involved in the attractive term also govern the prediction of VLE data in mixtures [28,29]. Through the present paper and the previous ones on similar topics [2072], it is desired to highlight the best practices for developing safe EoS, making it possible to define optimal models for pure components and mixtures, belonging indifferently to the SAFT or the cubic EoS family.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### CRediT authorship contribution statement

**Jean-Noël Jaubert:** Conceptualization, Writing – review & editing, Software. **Jun-Wei Qian:** Software. **Silvia Lasala:** Software, Writing – review & editing. **Romain Privat:** Conceptualization, Software, Writing – review & editing.

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### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.fluid.2022.113456.

### References

- [1] J.-N. Jaubert, F. Mutelet, VLE predictions with the Peng-Robinson equation of state and temperature-dependent  $k_{ij}$  calculated through a group contribution method, *Fluid Phase Equilibria* 224 (2004) 285–304, doi:10.1016/j.fluid.2004.06.059.
- [2] J.-N. Jaubert, S. Vitu, F. Mutelet, J.-P. Corriou, Extension of the PPR78 model (predictive 1978, Peng-Robinson EoS with temperature-dependent  $k_{ij}$  calculated through a group contribution method) to systems containing aromatic compounds, *Fluid Phase Equilibria* 237 (2005) 193–211, doi:10.1016/j.fluid.2005.09.003.
- [3] S. Vitu, J.-N. Jaubert, F. Mutelet, Extension of the PPR78 model (Predictive 1978, Peng-Robinson EoS with temperature-dependent  $k_{ij}$  calculated through a group contribution method) to systems containing naphthenic

- compounds, *Fluid Phase Equilibria* 243 (2006) 9–28, doi:10.1016/j.fluid.2006.02.004.
- [4] S. Vitu, R. Privat, J.-N. Jaubert, F. Mutelet, Predicting the phase equilibria of CO<sub>2</sub> + hydrocarbon systems with the PPR78 model (PR EoS and  $k_{ij}$  calculated through a group contribution method), *J. Supercrit. Fluids* 45 (2008) 1–26, doi:10.1016/j.supflu.2007.11.015.
- [5] R. Privat, J.-N. Jaubert, F. Mutelet, Addition of the nitrogen group to the PPR78 model (predictive 1978, Peng-Robinson EoS with temperature-dependent  $k_{ij}$  calculated through a group contribution method), *Ind. Eng. Chem. Res.* 47 (2008) 2033–2048, doi:10.1021/ie071524b.
- [6] R. Privat, J.-N. Jaubert, F. Mutelet, Use of the PPR78 model to predict new equilibrium data of binary systems involving hydrocarbons and nitrogen. Comparison with other GCEOS, *Ind. Eng. Chem. Res.* 47 (2008) 7483–7489, doi:10.1021/ie800636h.
- [7] R. Privat, F. Mutelet, J.-N. Jaubert, Addition of the hydrogen sulfide group to the PPR78 Model (Predictive 1978, Peng-Robinson equation of state with temperature-dependent  $k_{ij}$  calculated through a group contribution method), *Ind. Eng. Chem. Res.* 47 (2008) 10041–10052, doi:10.1021/ie800799z.
- [8] R. Privat, J.-N. Jaubert, F. Mutelet, Addition of the sulfhydryl group (-SH) to the PPR78 model (predictive 1978, Peng-Robinson EoS with temperature-dependent  $k_{ij}$  calculated through a group contribution method), *J. Chem. Thermodyn.* 40 (2008) 1331–1341, doi:10.1016/j.jct.2008.05.013.
- [9] R. Privat, J.-N. Jaubert, Addition of the sulfhydryl group (SH) to the PPR78 model: estimation of missing group-interaction parameters for systems containing mercaptans and carbon dioxide or nitrogen or methane, from newly published data, *Fluid Phase Equilibria* 334 (2012) 197–203, doi:10.1016/j.fluid.2012.08.007.
- [10] J.-W. Qian, R. Privat, J.-N. Jaubert, Predicting the phase equilibria, critical phenomena, and mixing enthalpies of binary aqueous systems containing alkanes, cycloalkanes, aromatics, alkenes, and gases (N<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>S, H<sub>2</sub>) with the PPR78 equation of state, *Ind. Eng. Chem. Res.* 52 (2013) 16457–16490, doi:10.1021/ie402541h.
- [11] J.-W. Qian, J.-N. Jaubert, R. Privat, Prediction of the phase behavior of alkene-containing binary systems with the PPR78 model, *Fluid Phase Equilibria* 354 (2013) 212–235, doi:10.1016/j.fluid.2013.06.040.
- [12] J.-W. Qian, J.-N. Jaubert, R. Privat, Phase equilibria in hydrogen-containing binary systems modeled with the Peng-Robinson equation of state and temperature-dependent binary interaction parameters calculated through a group-contribution method, *J. Supercrit. Fluids* 75 (2013) 58–71, doi:10.1016/j.supflu.2012.12.014.
- [13] F.J. Braña-Mulero, S. Hirohama, P. Lingampally, M. Sasaki, J.-N. Jaubert, Application of PPR78 thermodynamic framework as a fill method with a semiempirical mixing rule for mixtures involved in gas processing, *J. Chem. Eng. Data* 61 (2016) 4164–4171, doi:10.1021/acs.jced.6b00572.
- [14] R. Agarwal, Y.-K. Li, O. Santollani, M.A. Satyro, A. Vieler, *Uncovering the realities of simulation. Part II*, *Chem. Eng. Prog.* 97 (2001) 64–72.
- [15] J.-W. Qian, R. Privat, J.-N. Jaubert, P. Duchet-Suchaux, Enthalpy and heat capacity changes on mixing: fundamental aspects and prediction by means of the PPR78 cubic equation of state, *Energy Fuels* 27 (2013) 7150–7178, doi:10.1021/ef401605c.
- [16] J. Qian, *Développement du modèle E-PPR78 pour prédire les équilibres de phases et les grandeurs de mélange de systèmes complexes d'intérêt pétrolier sur de larges gammes de températures et de pressions*, Institut National Polytechnique de Lorraine, 2011.
- [17] J.-W. Qian, R. Privat, J.-N. Jaubert, C. Coquelet, D. Ramjugernath, Fluid-phase-equilibrium prediction of fluorocompound-containing binary systems with the predictive E-PPR78 model [Prévision en matière d'équilibre des phases de fluide des systèmes binaires contenant des fluorocomposés avec le modèle prédictif E-PPR78], *Int. J. Refrig.* 73 (2017) 65–90, doi:10.1016/j.ijrefrig.2016.09.013.
- [18] V. Plee, J.-N. Jaubert, R. Privat, P. Arpentinier, Extension of the E-PPR78 equation of state to predict fluid phase equilibria of natural gases containing carbon monoxide, helium-4 and argon, *J. Pet. Sci. Eng.* 133 (2015) 744–770, doi:10.1016/j.petrol.2015.03.025.
- [19] X. Xu, R. Privat, J.-N. Jaubert, Addition of the sulfur dioxide group (SO<sub>2</sub>), the oxygen group (O<sub>2</sub>) and the nitric oxide group (NO) to the E-PPR78 model, *Ind. Eng. Chem. Res.* 54 (2015) 9494–9504, doi:10.1021/acs.iecr.5b02639.
- [20] X. Xu, S. Lasala, R. Privat, J.-N. Jaubert, E-PPR78: a proper cubic EoS for modelling fluids involved in the design and operation of carbon dioxide capture and storage (CCS) processes, *Int. J. Greenh. Gas Control* 56 (2017) 126–154, doi:10.1016/j.ijggc.2016.11.015.
- [21] X. Xu, J.-N. Jaubert, R. Privat, P. Arpentinier, Prediction of thermodynamic properties of alkyne-containing mixtures with the E-PPR78 model, *Ind. Eng. Chem. Res.* 56 (2017) 8143–8157, doi:10.1021/acs.iecr.7b01586.
- [22] D.B. Robinson, D.-Y. Peng, The characterization of the heptanes and heavier fractions for the GPA Peng-Robinson programs (RR-28), *Res. Rep. GPA* (1978) 1–36.
- [23] J.-N. Jaubert, R. Privat, F. Mutelet, Predicting the phase equilibria of synthetic petroleum fluids with the PPR78 approach, *AIChE J* 56 (2010) 3225–3235, doi:10.1002/aic.12232.
- [24] H.-J. Huron, J. Vidal, New mixing rules for cubic equations of state for strongly nonideal mixtures, *Fluid Phase Equilibria* 3 (1979) 255–271.
- [25] J.-N. Jaubert, R. Privat, Relationship between the binary interaction parameters ( $k_{ij}$ ) of the Peng-Robinson and those of the Soave-Redlich-Kwong equations of state: Application to the definition of the PR2SRK model, *Fluid Phase Equilibria* 295 (2010) 26–37, doi:10.1016/j.fluid.2010.03.037.
- [26] R. Privat, J.-N. Jaubert, Y.Le Guennec, Incorporation of a volume translation in an equation of state for fluid mixtures: which combining rule? Which effect on properties of mixing?, *Fluid Phase Equilibria* 427 (2016) 414–420, doi:10.1016/j.fluid.2016.07.035.
- [27] J.-N. Jaubert, R. Privat, Y.Le Guennec, L. Coniglio, Note on the properties altered by application of a Pélououx-type volume translation to an equation of state, *Fluid Phase Equilibria* 419 (2016) 88–95, doi:10.1016/j.fluid.2016.03.012.
- [28] Y.Le Guennec, S. Lasala, R. Privat, J.-N. Jaubert, A consistency test for  $\alpha$ -functions of cubic equations of state, *Fluid Phase Equilibria* 427 (2016) 513–538, doi:10.1016/j.fluid.2016.07.026.
- [29] Y.Le Guennec, R. Privat, S. Lasala, J.-N. Jaubert, On the imperative need to use a consistent  $\alpha$ -function for the prediction of pure-compound supercritical properties with a cubic equation of state, *Fluid Phase Equilibria* 445 (2017) 45–53, doi:10.1016/j.fluid.2017.04.015.
- [30] Y.Le Guennec, R. Privat, J.-N. Jaubert, Development of the translated-consistent  $tc$ -PR and  $tc$ -RK cubic equations of state for a safe and accurate prediction of volumetric, energetic and saturation properties of pure compounds in the sub- and super-critical domains, *Fluid Phase Equilibria* 429 (2016) 301–312, doi:10.1016/j.fluid.2016.09.003.
- [31] A. Pina-Martinez, Y.Le Guennec, R. Privat, J.-N. Jaubert, P.M. Mathias, Analysis of the combinations of property data that are suitable for a safe estimation of consistent Twu  $\alpha$ -function parameters: updated parameter values for the translated-consistent  $tc$ -PR and  $tc$ -RK cubic equations of state, *J. Chem. Eng. Data* 63 (2018) 3980–3988, doi:10.1021/acs.jced.8b00640.
- [32] N. Ramírez-Vélez, A. Piña-Martinez, J.-N. Jaubert, R. Privat, Parameterization of SAFT models: analysis of different parameter estimation strategies and application to the development of a comprehensive database of PC-SAFT molecular parameters, *J. Chem. Eng. Data* 65 (2020) 5920–5932, doi:10.1021/acs.jced.0c00792.
- [33] R.C. Reid, J.M. Prausnitz, B.E. Poling, *The properties of gases and liquids*, 4th ed, McGraw-Hill, New York, 1987.
- [34] A. Chiko, I. Polishuk, Comparison of CP-PC-SAFT and PC-SAFT with  $k_{12}=0$  and PPR78 in Predicting Binary Systems of Hydrocarbons with Squalane, *n*-dodecylbenzene, *cis*-decalin, Tetralin, and Naphthalene at High Pressures, *Ind. Eng. Chem. Res.* 60 (2021) 15805–15816, doi:10.1021/acs.iecr.1c03486.
- [35] J.-N. Jaubert, Y.Le Guennec, A. Piña-Martinez, N. Ramírez-Vélez, S. Lasala, B. Schmid, I.K. Nikolaidis, I.G. Economou, R. Privat, Benchmark database containing binary-system-high-quality-certified data for cross-comparing thermodynamic models and assessing their accuracy, *Ind. Eng. Chem. Res.* 59 (2020) 14981–15027, doi:10.1021/acs.iecr.0c01734.
- [36] I.K. Nikolaidis, R. Privat, J.-N. Jaubert, I.G. Economou, Assessment of the perturbed chain-statistical associating fluid theory equation of state against a benchmark database of high-quality binary-system data, *Ind. Eng. Chem. Res.* 60 (2021) 8935–8946, doi:10.1021/acs.iecr.1c01234.
- [37] A. Piña-Martinez, R. Privat, I.K. Nikolaidis, I.G. Economou, J.-N. Jaubert, What is the optimal activity coefficient model to be combined with the translated-consistent Peng-Robinson equation of state through advanced mixing rules? Cross-comparison and grading of the Wilson, uniuqac, and NRTL  $\alpha^E$  models against a benchmark database involving 200 binary systems, *Ind. Eng. Chem. Res.* 60 (2021) 17228–17247, doi:10.1021/acs.iecr.1c03003.
- [38] A.Q. Clark, K. Stead, (Vapour + liquid) phase equilibria of binary, ternary, and quaternary mixtures of CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>, C<sub>4</sub>H<sub>10</sub>, and CO<sub>2</sub>, *J. Chem. Thermodyn.* 20 (1988) 413–427, doi:10.1016/0021-9614(88)90178-4.
- [39] W.B. Kay, Vapor-liquid equilibrium relations of binary systems. Propane-*n*-alkane systems. *n*-Butane and *n*-pentane, *J. Chem. Eng. Data* 15 (1970) 46–52, doi:10.1021/je60044a026.
- [40] P. Beránek, I. Wichterle, Vapor-liquid equilibria in the propane-*n*-butane system at high pressures, *Fluid Phase Equilibria* 6 (1981) 279–282, doi:10.1016/0378-3812(81)85010-8.
- [41] L. Cummings, Ph.D. Thesis, Mass. Inst. Techn. (1933).
- [42] K. Yokoyama, S. Ohe, *Jap J Technol UDC* 11 (1966).
- [43] B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems Propane-*n*-Pentane System1, *Ind. Eng. Chem.* 32 (1940) 992–996, doi:10.1021/ie50367a030.
- [44] J. Vejrosta, I. Wichterle, The propane-pentane system at high pressure, *Collect. Czech. Chem. Commun.* 39 (2022) 1246–1248.
- [45] K. Ishida, K. Noda, K. Hirako, Vapor-liquid equilibria for the system containing liquefied petroleum gas. Vapor-liquid equilibria for the propane-*n*-hexane and propane-*n*-hexadecane system, *Asahi Garasu Kogyo Gijutsu Shoreikai Kenkyu Hokoku* 26 (1975) 355–360.
- [46] W.B. Kay, Vapor-liquid equilibrium relations of binary systems. Propane-*n*-alkane systems, *n*-hexane, and *n*-heptane, *J. Chem. Eng. Data* 16 (1971) 137–140, doi:10.1021/je60049a013.
- [47] C.J. Wormald, E.J. Lewis, D.J. Hutchings, Excess enthalpies of gaseous mixtures of *n*-alkanes, *J. Chem. Thermodyn.* 11 (1979) 1–12, doi:10.1016/0021-9614(79)90076-4.
- [48] J.L. Guillevic, D. Richon, H. Renon, Vapor-liquid equilibrium measurements up to 558 K and 7 MPa: a new apparatus, *Ind. Eng. Chem. Fundam.* 22 (1983) 495–499, doi:10.1021/i100012a022.
- [49] W.B. Kay, J. Genco, D.A. Fichtner, Vapor-liquid equilibrium relations of binary systems propane-*n*-octane and butane-*n*-octane, *J. Chem. Eng. Data* 19 (1974) 275–280, doi:10.1021/je60062a017.
- [50] D.W. Jennings, R.C. Schucker, Comparison of high-pressure vapor-liquid

- equilibria of mixtures of CO<sub>2</sub> or propane with nonane and C9 alkylbenzenes, *J. Chem. Eng. Data*. 41 (1996) 831–838, doi:10.1021/jc960033n.
- [51] H.H. Reamer, B.H. Sage, Phase equilibria in hydrocarbon systems. volumetric and phase behavior of the propane-n-decane system, *J. Chem. Eng. Data*. 11 (1966) 17–24, doi:10.1021/jc60028a004.
- [52] J. Gregorowicz, T.W. De Loos, J. De Swaan Arons, The system propane + eicosane: P, T, and x measurements in the temperature range 288–358 K, *J. Chem. Eng. Data*. 37 (1992) 356–358, doi:10.1021/jc00007a022.
- [53] G. Calingaert, L.B. Hitchcock, The application of the phase rule to the calculation of liquid and vapor compositions in binary systems. deviations from Raoult's law for hydrocarbon mixtures, *J. Am. Chem. Soc.* 49 (1927) 750–765, doi:10.1021/ja01402a018.
- [54] W.B. Kay, R.L. Hoffman, O. Davies, Vapor-liquid equilibrium relations of binary systems n-butane-n-pentane and n-butane-n-hexane, *J. Chem. Eng. Data*. 20 (1975) 333–338, doi:10.1021/jc60066a021.
- [55] A. Hoepfner, U.T. Kreibich, K. Schaefer, Ber. Bunsenges, Effect of molecular formula on the thermodynamic properties of organic nonelectrolyte systems of nonpolar liquids, *Phys Chem* 74 (1970) 1016–1020.
- [56] K. Yokoyama, S. Ohe, Studies on apparatus for measuring vapor-liquid equilibrium at high pressures, *Ishikawajima-Harima Giho* 11 (1971) 5–11.
- [57] W.B. Kay, Liquid-vapor equilibrium relations in binary systems: n-butane-n-heptane system, *Ind Eng Chem* 33 (1941) 590–594.
- [58] H.H. Reamer, B.H. Sage, Phase equilibria in hydrocarbon systems. phase behavior in the n-butane-n-decane system, *J. Chem. Eng. Data*. 9 (1964) 24–28, doi:10.1021/jc60020a009.
- [59] V.V. de Leeuw, T.W. de Loos, H.A. Kooijman, J. de, S. Arons, The experimental determination and modelling of VLE for binary subsystems of the quaternary system N<sub>2</sub> + CH<sub>4</sub> + C<sub>4</sub>H<sub>10</sub> + C<sub>14</sub>H<sub>30</sub> UP to 1000 bar and 440 K, *Fluid Phase Equilibria* 73 (1992) 285–321, doi:10.1016/0378-3812(92)80015-2.
- [60] S.-S. Chen, B.J. Zwolinski, Excess thermodynamic functions of binary mixtures of normal and isomeric alkanes (C<sub>5</sub> and C<sub>6</sub>), *J. Chem. Soc. Faraday Trans. 2 Mol. Chem. Phys.* 70 (1974) 1133–1142, doi:10.1039/F29747001133.
- [61] F.G. Tenn, R.W. Missen, A study of the condensation of binary vapors of miscible liquids: part i: the equilibrium relations, *Can. J. Chem. Eng.* 41 (1963) 12–14, doi:10.1002/cjce.5450410105.
- [62] P. Rice, A. El-Nikheli, Isothermal vapour-liquid equilibrium data for the systems n-pentane with n-hexane, n-octane and n-decane, *Fluid Phase Equilibria* 107 (1995) 257–267, doi:10.1016/0378-3812(95)02679-9.
- [63] K. Günzel, H.-J. Bittrich, Mischungsenthalpien binärer Systeme mit Olefinen und Diolenen, *Z. Für Phys. Chem.* 258 (1977) 1073–1080.
- [64] D.L. Katz, G.G. Brown, Vapor pressure and vaporization of petroleum fractions, *Ind. Eng. Chem.* 25 (1933) 1373–1384, doi:10.1021/ie50288a018.
- [65] W.T. Cummings, F.W. Stones, M.A. Volante, High pressure rectification: II. n-pentane-n-heptane system, *Ind Eng Chem* 25 (1933) 728–732.
- [66] P. Chueh, J. Prausnitz, D. Behrens, R. Eckermann (Eds.), Vapor-liquid equilibria for mixtures of low boiling substances, *Chemistry Data Series, VI, DEHEMA* (1982).
- [67] M.L. McGlashan, K.W. Morcom, Heats of mixing of some n-alkanes, *Trans. Faraday Soc.* 57 (1961) 907–913, doi:10.1039/TF9615700907.
- [68] H.A. Beatty, George. Calingaert, Vapor-liquid equilibrium of hydrocarbon mixtures, *Ind. Eng. Chem.* 26 (1934) 504–508, doi:10.1021/ie50293a007.
- [69] C.P. Smyth, E.W. Engel, Molecular orientation and the partial vapor pressures of binary mixtures. i. systems composed of normal liquids, *J. Am. Chem. Soc.* 51 (1929) 2646–2660, doi:10.1021/ja01384a006.
- [70] V. Zharov, T. Vitman, Eesti NSV Tead Akad Toim Keem Geol 20 (1971) 206–209.
- [71] E.H. Leslie, A.R. Carr, Vapor pressure of organic solutions, *Ind. Eng. Chem.* 17 (1925) 810–817, doi:10.1021/ie50188a013.
- [72] J. Zielkiewicz, Vapour + liquid) equilibria in (propan-1-ol + n-hexane + n-heptane) at the temperature 313.15 K, *J. Chem. Thermodyn.* 23 (1991) 605–612, doi:10.1016/S0021-9614(91)80103-X.
- [73] D.S. Jan, H.Y. Shiau, F.N. Tsai, Vapor-liquid equilibria of n-Hexane + Cyclohexane + n-heptane and the three constituent binary systems at 101.0 kPa, *J. Chem. Eng. Data*. 39 (1994) 438–440, doi:10.1021/jc00015a007.
- [74] A.R. Mathieson, J.C.J. Thynne, Thermodynamics of hydrocarbon mixtures. Part II. the heats of mixing of the binary mixtures formed by benzene, cyclohexane, n-heptane, toluene, and n-hexane, *J. Chem. Soc. Resumed.* (1956) 3708–3713, doi:10.1039/JR9560003708.
- [75] F. Kimura, G.C. Benson, C.J. Halpin, Excess enthalpies of binary mixtures of n-heptane with hexane isomers, *Fluid Phase Equilibria* 11 (1983) 245–250, doi:10.1016/0378-3812(83)85027-4.
- [76] A. Saito, R. Tanaka, Excess volumes and heat capacities of binary mixtures formed from cyclohexane, hexane, and heptane at 298.15 K, *J. Chem. Thermodyn.* 20 (1988) 859–865, doi:10.1016/0021-9614(88)90075-4.
- [77] G.C. Benson, P.J. D'Arcy, M.K. Kumaran, Heat capacities of binary mixtures of n-heptane with hexane isomers, *Thermochim. Acta.* 75 (1984) 353–360, doi:10.1016/0040-6031(84)85038-8.
- [78] V.A. Kireev, V.T. Bykon, V.V. Khodorchenko, Heat of mixing of liquids. V. heat of mixing of benzene with dichloroethane, benzene with carbon tetrachloride and hexane with heptane, *Zh. Fiz. Khim.* 10 (1937) 807–812.
- [79] H. Kirss, L. Kudryavtseva, O. Eisen, Eesti NSV teaduste akadeemia toimetised, *Eesti NSV Tead. Akad. Toim. Keem. Geoloogia.* 24 (1975) 15–22.
- [80] S. Weiguo, A.X. Qin, P.J. McElroy, A.G. Williamson, Vapour + liquid) equilibria of (n-hexane + n-hexadecane), (n-hexane + n-octane), and (n-octane + n-hexadecane), *J. Chem. Thermodyn.* 22 (1990) 905–914, doi:10.1016/0021-9614(90)90179-T.
- [81] S.E.M. Hamam, M.K. Kumaran, G.C. Benson, Excess enthalpies of binary mixtures of n-octane with each of the hexane isomers at 298.15 K, *Fluid Phase Equilibria* 18 (1984) 147–154, doi:10.1016/0378-3812(84)87003-X.
- [82] P. Tancrede, D. Patterson, Excess enthalpy. n-Octane-n-hexane system, *Int Data Ser Sel Data Mix. Ser A.* 1 (1974) 24–35.
- [83] A. Heintz, R.N. Lichtenthaler, Excess enthalpies of liquid alkane mixtures at pressures up to 500 bar I. experimental results, *Berichte Bunsenges. Für Phys. Chem.* 84 (1980) 727–732, doi:10.1002/bbpc.19800840808.
- [84] G.C. Benson, P.J. D'Arcy, Heat capacities of binary mixtures of n-octane with each of the hexane isomers at 298.15 K, *Can. J. Chem.* 64 (1986) 2139–2141, doi:10.1139/v86-352.
- [85] K.N. Marsh, J.B. Ott, M.J. Costigan, Excess enthalpies, excess volumes, and excess Gibbs free energies for (n-hexane + n-decane) at 298.15 and 308.15 K, *J. Chem. Thermodyn.* 12 (1980) 343–348, doi:10.1016/0021-9614(80)90146-9.
- [86] M. López, M.I.P. Andrade, J. Peleteiro, J.L. Legido, L. Romani, E.P. Martell, Excess molar enthalpies of the ternary systems pentan-3-one + n-hexane + n-decane and n-tetradecane at 298.15 K, *Thermochim. Acta.* 211 (1992) 33–42, doi:10.1016/0040-6031(92)87004-T.
- [87] S.K. Ogorodnikov, V.B. Kogan, A.I. Morozova, Liquid-vapor equilibrium in the system ethylene glycol-water, *Zh. Prikl. Khim.* 35 (1962) 685–687.
- [88] S.E.M. Hamam, G.C. Benson, Excess enthalpies of binary mixtures of n-decane with hexane isomers, *J. Chem. Eng. Data*. 31 (1986) 45–47, doi:10.1021/jc00043a015.
- [89] J.G. Fernández-García, Ch.G. Boissonnas, Propriétés thermodynamiques des mélanges binaires. Chaleurs de mélange des n-alcane ainsi que de leurs isomères, *Helv. Chim. Acta.* 50 (1967) 1059–1068, doi:10.1002/hlca.19670500411.
- [90] J.H. van der Waals, Thermodynamic properties of some binary alkane mixtures at constant volume, *Trans. Faraday Soc.* 52 (1956) 916–925, doi:10.1039/TF9565200916.
- [91] J.B. Ott, K.N. Marsh, R.H. Stokes, Excess enthalpies, excess volumes, and excess Gibbs free energies for (n-hexane + n-dodecane) at 298.15 and 308.15 K, *J. Chem. Thermodyn.* 13 (1981) 371–376, doi:10.1016/0021-9614(81)90027-6.
- [92] M.K. Kumaran, G.C. Benson, P.J. D'Arcy, C.J. Halpin, Speed of sound, molar volume, and molar isobaric heat capacity for binary liquid mixtures: analysis in terms of van der Waals's one-fluid theory, *J. Chem. Thermodyn.* 16 (1984) 1181–1189, doi:10.1016/0021-9614(84)90190-3.
- [93] M. López, E. Carballo, J.L. Legido, J. Salgado, J. Vijande, M.I. Paz Andrade, Excess molar enthalpies of {x1CH<sub>3</sub>CH<sub>2</sub>COCH<sub>2</sub>CH<sub>3</sub>+x2CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>CH<sub>3</sub>+ (1-x1-x2)CH<sub>3</sub>(CH<sub>2</sub>)<sub>v</sub>-2CH<sub>3</sub>} (v = 9 and 12) at the temperature 298.15 K, *J. Chem. Thermodyn.* 27 (1995) 879–886, doi:10.1006/jcht.1995.0093.
- [94] J.H. van der Waals, Thermodynamic properties of mixtures of alkanes differing in chain length, III: the system hexane-dodecane, *Recl. Trav. Chim. Pays-Bas.* 70 (1951) 101–104, doi:10.1002/recl.19510700202.
- [95] M.L. McGlashan, A.G. Williamson, Thermodynamics of mixtures of n-hexane + n-hexadecane. Part 2.—vapour pressures and activity coefficients, *Trans. Faraday Soc.* 57 (1961) 588–600, doi:10.1039/TF9615700588.
- [96] J.H. Hildebrand, Several solutions of non-polar substances, *J. Phys. Chem.* 43 (1939) 109–117, doi:10.1021/ji50388a008.
- [97] J.A. Larkin, D.V. Fenby, T.S. Gilman, R.L. Scott, Heats of Mixing of Nonelectrolyte Solutions. III. Solutions of the Five Hexane Isomers with Hexadecane, *J. Phys. Chem.* 70 (1966) 1959–1963, doi:10.1021/ji00878a043.
- [98] R.C. Miller, A.G. Williamson, Excess molar enthalpies for (n-hexane + n-hexadecane) and for three- and four-component alkane mixtures simulating this binary mixture, *J. Chem. Thermodyn.* 16 (1984) 793–799, doi:10.1016/0021-9614(84)90064-8.
- [99] K.N. Marsh, P.P. Organ, Excess molar enthalpies and excess molar volumes for three- and four-component n-alkane mixtures simulating (n-hexane + n-hexadecane), *J. Chem. Thermodyn.* 17 (1985) 835–841, doi:10.1016/0021-9614(85)90076-x.
- [100] Th. Holleman, Heats of mixing of liquid binary normal alkane mixtures, *Physica* 31 (1965) 49–63, doi:10.1016/0031-8914(65)90105-9.
- [101] T.J. Brady, S. Weiguo, A.G. Williamson, Enthalpies of mixing of multicomponent alkane mixtures, *Aust. J. Chem.* 41 (1988) 1763–1767, doi:10.1071/ch9881763.
- [102] G. Scatchard, L.B. Ticknor, J.R. Goates, E.R. McCartney, Heats of mixing in some non-electrolyte solutions, *J. Am. Chem. Soc.* 74 (1952) 3721–3724, doi:10.1021/ja01135a002.
- [103] J. Fernandez-García, F. Stoeckli, Ch.G. Boissonnas, 238. Propriétés thermodynamiques des mélanges binaires. volumes de mélange des n-alcane, *Helv. Chim. Acta.* 49 (1966) 1983–1986, doi:10.1002/hlca.660490705.
- [104] L.S. Kudryavtseva, H. Viit, O.G. Eisen, Vapor-liquid equilibrium in 1-heptene-heptane, 1-heptene-octane, heptane-octane, benzene-thiophene, benzene-heptane, and thiophene-heptane binary systems at 55 deg, *Eesti NSV Tead Akad Toim Keem Geol* 20 (1971) 292–296.
- [105] J. Wisniak, G. Embon, R. Shafir, H. Segura, R. Reich, Isobaric vapor-liquid equilibria in the systems methyl 1,1-dimethylethyl ether + octane and heptane + octane, *J. Chem. Eng. Data.* 42 (1997) 1191–1194, doi:10.1021/jc970126k.
- [106] Z. Wang, Y. Horikawa, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of the ternary mixtures: diisopropyl ether + n-octane + (n-heptane or n-dodecane)

- at 298.15 K, Fluid Phase Equilibria 181 (2001) 215–224, doi:[10.1016/S0378-3812\(01\)00500-3](https://doi.org/10.1016/S0378-3812(01)00500-3).
- [107] A. Dejoz, V. González-Alfaro, P.J. Miguel, M.I. Vázquez, Isoobaric vapor-liquid equilibria for binary systems composed of octane, decane, and dodecane at 20 kPa, J. Chem. Eng. Data. 41 (1996) 93–96, doi:[10.1021/je950177m](https://doi.org/10.1021/je950177m).
- [108] Z. Wang, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of the ternary mixtures 2-methyltetrahydrofuran + n-octane + (n-decane or n-dodecane) at 298.15 K, J. Chem. Eng. Data. 46 (2001) 1193–1197, doi:[10.1021/je010127j](https://doi.org/10.1021/je010127j).
- [109] R.B. Grigg, J.R. Goates, J.B. Ott, Excess volumes and excess enthalpies for (n-dodecane + n-octane) and excess volumes for (n-dodecane + cyclohexane) at 298.15 K, J. Chem. Thermodyn. 14 (1982) 101–102, doi:[10.1016/0021-9614\(82\)90129-X](https://doi.org/10.1016/0021-9614(82)90129-X).
- [110] M.K. Kumaran, G.C. Benson, Excess enthalpies of n-dodecane + n-heptane, + n-octane, and + n-decane at 298.15 K, J. Chem. Thermodyn. 18 (1986) 993–996, doi:[10.1016/0021-9614\(86\)90156-4](https://doi.org/10.1016/0021-9614(86)90156-4).
- [111] R.C. Miller, A.J. Kidnay, M.J. Hiza, Liquid + vapor equilibria in methane + ethene and in methane + ethane with 150.00 to 190.00 K, J. Chem. Thermodyn. 9 (1977) 167–178, doi:[10.1016/0021-9614\(77\)90082-9](https://doi.org/10.1016/0021-9614(77)90082-9).
- [112] I. Wichterle, R. Kobayashi, Vapor-liquid equilibrium of methane-ethane system at low temperatures and high pressures, J. Chem. Eng. Data. 17 (1972) 9–12, doi:[10.1021/je60052a022](https://doi.org/10.1021/je60052a022).
- [113] I. Wichterle, R. Kobayashi, Vapor-liquid equilibrium of methane-ethane-propane system at low temperatures and high pressures, J. Chem. Eng. Data. 17 (1972) 13–18, doi:[10.1021/je60052a017](https://doi.org/10.1021/je60052a017).
- [114] A. Price, 1957.
- [115] J. Davalos, W.R. Anderson, R.E. Phelps, A.J. Kidnay, Liquid-vapor equilibria at 250.00 deg.K for systems containing methane, ethane, and carbon dioxide, J. Chem. Eng. Data. 21 (1976) 81–84, doi:[10.1021/je60068a030](https://doi.org/10.1021/je60068a030).
- [116] M.K. Gupta, G.C. Gardner, M.J. Hegarty, A.J. Kidnay, Liquid-vapor equilibria for the N<sub>2</sub> + CH<sub>4</sub> + C<sub>2</sub>H<sub>6</sub> system from 260 to 280 K, J. Chem. Eng. Data. 25 (1980) 313–318, doi:[10.1021/je60087a016](https://doi.org/10.1021/je60087a016).
- [117] A.R. Price, R. Kobayashi, Low temperature vapor-liquid equilibrium in light hydrocarbon mixtures: methane-ethane-propane system, J. Chem. Eng. Data. 4 (1959) 40–52, doi:[10.1021/je60001a007](https://doi.org/10.1021/je60001a007).
- [118] M.S.-W. Wei, T.S. Brown, A.J. Kidnay, E.D. Sloan, Vapor + liquid equilibria for the ternary system methane + ethane + carbon dioxide at 230 K and its constituent binaries at temperatures from 207 to 270 K, J. Chem. Eng. Data. 40 (1995) 726–731, doi:[10.1021/je00020a002](https://doi.org/10.1021/je00020a002).
- [119] E.J.S. Gomes de Azevedo, J.C.G. Calado, Thermodynamics of liquid methane+ethane, Fluid Phase Equilibria 49 (1989) 21–34, doi:[10.1016/0378-3812\(89\)80003-2](https://doi.org/10.1016/0378-3812(89)80003-2).
- [120] G.M. Wilson, Vapor-liquid equilibria of nitrogen, methane, ethane, and propane binary mixtures at LNG temperatures from total pressure measurements. [For use in design of equipment for storage and handling of LNG], Adv Cryog Eng U. S. 20 (1975) 164–171.
- [121] S. VG, I.E. Nikitina, L.A. Zhdanovich, A.G. Sirotnin, O.A. Ben'aminovich, Liquid-vapor phase equilibria at low temperatures in binary systems formed by components of natural gas, Gazov Prom-St 15 (1970) 35–36.
- [122] D.J. Hutchings, E.J. Lewis, C.J. Wormald, Excess enthalpies of mixtures of methane + each of the n-alkanes from ethane to n-octane, J. Chem. Thermodyn. 10 (1978) 559–566, doi:[10.1016/0021-9614\(78\)90044-7](https://doi.org/10.1016/0021-9614(78)90044-7).
- [123] R.C. Miller, L.A.K. Staveley, Excess enthalpies for some binary liquid mixtures of low-molecular-weight alkanes, in: K.D. Timmerhaus, D.H. Weitzel (Eds.), Adv. Cryog. Eng., Springer US, Boston, MA, 1975, pp. 493–500, doi:[10.1007/978-1-4757-0208-8\\_58](https://doi.org/10.1007/978-1-4757-0208-8_58).
- [124] J.B. Ott, R.B. Grigg, J.R. Goates, Excess enthalpies and excess volumes for n-hexane + 2-methylpentane, + 3-methylpentane and + 2,3-dimethylbutane at 283.15, 298.15 and 313.15 K, Aust. J. Chem. 33 (1980) 1921–1926, doi:[10.1071/ch9801921](https://doi.org/10.1071/ch9801921).
- [125] J.G. Fernández-García, M. Guillemin, C.G. Boissonnas, Propriétés thermodynamiques des mélanges binaires Énergie libre et entropie de formation des solutions de l'hexadécane dans les isomères de l'hexane, Helv. Chim. Acta. 51 (1968) 1733–1737, doi:[10.1002/hlca.19680510730](https://doi.org/10.1002/hlca.19680510730).
- [126] E.K. Liu, R.R. Davison, Vapor-liquid equilibria for the binary systems n-octane with 2-methylpentane, 3-methylpentane, and 2,4-dimethylpentane, J. Chem. Eng. Data. 26 (1981) 85–88, doi:[10.1021/je00023a026](https://doi.org/10.1021/je00023a026).
- [127] S.E.M. Hamam, M.K. Kumaran, D. Zhang, G.C. Benson, Excess enthalpies of binary mixtures of 2,4-dimethylpentane with n-hexane, n-heptane, n-octane and n-dodecane, J. Chem. Eng. Data. 30 (1985) 222–224, doi:[10.1021/je00040a029](https://doi.org/10.1021/je00040a029).
- [128] A.V. Kozenkov, V.P. Kononov, Yu.I. Malenko, Viniti. 1 (1980) 3065–3080.
- [129] C. Berro, F. Laichoubi, E. Rauzy, Isothermal vapor-liquid equilibria and excess volumes for the systems n-hexane + ethylbenzene, 2-methylpentane + n-heptane, and 2-methylpentane + n-octane, J. Chem. Eng. Data. 36 (1991) 474–478, doi:[10.1021/je00004a037](https://doi.org/10.1021/je00004a037).
- [130] W. Ameling, M.A. Siddiqi, K. Lucas, Excess enthalpies for the binary systems n-octane with 2-methylpentane and 3-methylpentane, J. Chem. Eng. Data. 28 (1983) 184–186, doi:[10.1021/je00032a016](https://doi.org/10.1021/je00032a016).
- [131] H. Hipkin, Experimental vapor-liquid equilibrium data for propane-isobutane, AIChE J 12 (1966) 484–487, doi:[10.1002/aic.690120317](https://doi.org/10.1002/aic.690120317).
- [132] J.A. Martínez-Ortiz, D.B. Manley, Vapor pressures for the system isobutane-isobutylene-n-butane, J. Chem. Eng. Data. 23 (1978) 165–167, doi:[10.1021/je60077a012](https://doi.org/10.1021/je60077a012).
- [133] M. Hirata, S. Suda, Equilibrium measurements by the vapor-liquid flow method, Bull. Jpn. Pet. Inst. 10 (1968) 20–27, doi:[10.1627/jpi1959.10.20](https://doi.org/10.1627/jpi1959.10.20).
- [134] W.E. Vaughan, F.C. Collins, P-V-T Relations of the System Propane-Isopentane, Ind. Eng. Chem. 34 (1942) 885–890, doi:[10.1021/ie50391a027](https://doi.org/10.1021/ie50391a027).
- [135] C. Berro, F. Laichoubi, E. Rauzy, Isothermal (vapor + liquid) equilibria and excess volumes of (3-methylpentane + heptane), of (2-methylpentane + octane), and of (toluene + octane), J. Chem. Thermodyn. 26 (1994) 863–869, doi:[10.1006/jcht.1994.1103](https://doi.org/10.1006/jcht.1994.1103).
- [136] Z. Wang, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of the ternary mixtures: {tetrahydrofuran+3-methylpentane+(octane or decane)} at the temperature 298.15 K, J. Chem. Thermodyn. 35 (2003) 1635–1644, doi:[10.1016/S0021-9614\(03\)00148-4](https://doi.org/10.1016/S0021-9614(03)00148-4).
- [137] C.L. Ho, R.R. Davison, Vapor-liquid equilibria for the binary systems n-hexane with 2-methylpentane, 3-methylpentane, and 2,4-dimethylpentane, J. Chem. Eng. Data. 24 (1979) 293–296, doi:[10.1021/je60083a008](https://doi.org/10.1021/je60083a008).
- [138] J.A. Abara, D.W. Jennings, W.B. Kay, A.S. Teja, Phase behavior in the critical region of six binary mixtures of 2-methyl alkanes, J. Chem. Eng. Data. 33 (1988) 242–247, doi:[10.1021/je00053a006](https://doi.org/10.1021/je00053a006).
- [139] S.W. Chun, J.C. Rainwater, W.B. Kay, Vapor-liquid equilibria of mixtures of propane and isomeric hexanes, J. Chem. Eng. Data. 38 (1993) 494–501, doi:[10.1021/je00012a003](https://doi.org/10.1021/je00012a003).
- [140] D.P.L. Poon, B.C.-Y. Lu, Phase Equilibria for Systems Containing Nitrogen, Methane, and Propane, in: K.D. Timmerhaus (Ed.), Adv. Cryog. Eng., Springer US, Boston, MA, 1995, pp. 292–299, doi:[10.1007/978-1-4613-9847-9\\_36](https://doi.org/10.1007/978-1-4613-9847-9_36).
- [141] I. Wichterle, R. Kobayashi, Vapor-liquid equilibrium of methane-propane system at low temperatures and high pressures, J. Chem. Eng. Data. 17 (1972) 4–9, doi:[10.1021/je60052a019](https://doi.org/10.1021/je60052a019).
- [142] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. Volumetric and Phase Behavior of the Methane-Propane System, Ind. Eng. Chem. 42 (1950) 534–539, doi:[10.1021/ie50483a037](https://doi.org/10.1021/ie50483a037).
- [143] W.W. Akers, J.F. Burns, W.R. Fairchild, Low-Temperature Phase Equilibria: Methane-Propane System, Ind. Eng. Chem. 46 (1954) 2531–2534, doi:[10.1021/ie50540a038](https://doi.org/10.1021/ie50540a038).
- [144] L.C. Kahre, Low-temperature K data for methane-butane, J. Chem. Eng. Data. 19 (1974) 67–71, doi:[10.1021/je60060a014](https://doi.org/10.1021/je60060a014).
- [145] R.H. Sage, B.L. Hicks, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems, Ind. Eng. Chem. 32 (1940) 1085–1092, doi:[10.1021/ie50368a014](https://doi.org/10.1021/ie50368a014).
- [146] L.R. Roberts, R.H. Wang, A. Azarnooosh, J.J. McKetta, Methane-n-Butane System in the Two-Phase Region, J. Chem. Eng. Data. 7 (1962) 484–485, doi:[10.1021/je60015a013](https://doi.org/10.1021/je60015a013).
- [147] D.G. Elliot, R.J.J. Chen, P.S. Chappellear, R. Kobayashi, Vapor-liquid equilibrium of methane-butane system at low temperatures and high pressures, J. Chem. Eng. Data. 19 (1974) 71–77, doi:[10.1021/je60060a015](https://doi.org/10.1021/je60060a015).
- [148] H.C. Wiese, J. Jacobs, B.H. Sage, Phase equilibria in the hydrocarbon systems. phase behavior in the methane-propane-n-butane system, J. Chem. Eng. Data. 15 (1970) 82–91, doi:[10.1021/je60044a021](https://doi.org/10.1021/je60044a021).
- [149] B.H. Sage, H.H. Reamer, R.H. Olds, W.N. Lacey, Phase equilibria in hydrocarbon systems, Ind. Eng. Chem. 34 (1942) 1108–1117, doi:[10.1021/ie50393a021](https://doi.org/10.1021/ie50393a021).
- [150] T.-C. Chu, R.J.J. Chen, P.S. Chappellear, R. Kobayashi, Vapor-liquid equilibrium of methane-n-pentane system at low temperatures and high pressures, J. Chem. Eng. Data. 21 (1976) 41–44, doi:[10.1021/je60068a012](https://doi.org/10.1021/je60068a012).
- [151] L.C. Kahre, Low-temperature K data for methane-n-pentane, J. Chem. Eng. Data. 20 (1975) 363–367, doi:[10.1021/je60067a027](https://doi.org/10.1021/je60067a027).
- [152] Brymer, Williams, N.W. Prodany, Vapor-liquid equilibria in methane-hydrocarbon systems, J. Chem. Eng. Data. 16 (1971) 1–6, doi:[10.1021/je60048a015](https://doi.org/10.1021/je60048a015).
- [153] K. Nagahama, S. Suzuki, S. Oba, M. Hirata, Isothermal binary and ternary vapor-liquid equilibria for the systems containing methane, carbon dioxide, n-pentane and n-heptane at high pressures, Sekiyu Gakkaishi 28 (1985) 63–69.
- [154] V. Berry, B. Sage, Natl. Stand. Ref. Data Ser. US Natl. Bur. Stand. (1970) 31–105.
- [155] H.S. Taylor, G.W. Wald, B.H. Sage, W.N. Lacey, Phase behavior of the methane-n-pentane system, Oil Gas J. 38 (1939) 46–50.
- [156] J. Shim, J.P. Kohn, Multiphase and volumetric equilibria of methane-n-hexane binary system at temperatures between -110° and 150°C, J. Chem. Eng. Data. 7 (1962) 3–8, doi:[10.1021/je60012a002](https://doi.org/10.1021/je60012a002).
- [157] R.D. Gunn, J.J. McKetta, N. Ata, Measurement and prediction of high-pressure phase equilibria with a dilute component in the gas phase: the methane-n-hexane system, AIChE J 20 (1974) 347–353, doi:[10.1002/aic.690200221](https://doi.org/10.1002/aic.690200221).
- [158] Y.-N. Lin, R.J.J. Chen, P.S. Chappellear, R. Kobayashi, Vapor-liquid equilibrium of the methane-n-hexane system at low temperature, J. Chem. Eng. Data. 22 (1977) 402–408, doi:[10.1021/je60075a007](https://doi.org/10.1021/je60075a007).
- [159] P. Marteau, J. Obriot, A. Barreau, V. Ruffier-Meray, E. Behar, Experimental determination of the phase behavior of binary mixtures: methane-hexane and methane-benzene, Fluid Phase Equilibria 129 (1997) 285–305, doi:[10.1016/S0378-3812\(96\)03125-1](https://doi.org/10.1016/S0378-3812(96)03125-1).
- [160] S. Srivastan, N.A. Darwish, K.A.M. Gasem, R.L. Robinson, Solubility of methane in hexane, decane, and dodecane at temperatures from 311 to 423 K and pressures to 10.4 MPa, J. Chem. Eng. Data. 37 (1992) 516–520, doi:[10.1021/je00008a033](https://doi.org/10.1021/je00008a033).
- [161] H.L. Chang, L.J. Hurt, R. Kobayashi, Vapor-liquid equilibria of light hydrocarbons at low temperatures and high pressures: the methane-n-heptane system, AIChE J. 12 (1966) 1212–1216, doi:[10.1002/aic.690120629](https://doi.org/10.1002/aic.690120629).
- [162] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase equilibria in hydrocarbon systems. volumetric and phase behavior of the methane-n-heptane system, Ind. Eng. Chem. Chem. Eng. Data Ser. 1 (1956) 29–42, doi:[10.1021/j460001a007](https://doi.org/10.1021/j460001a007).
- [163] J.P. Kohn, Heterogeneous phase and volumetric behavior of the methane

- n-heptane system at low temperatures, *AIChE J.* 7 (1961) 514–518, doi:10.1002/aic.690070334.
- [164] H. Schlichting, R. Langhorst, H. Knapp, Saturation of high pressure gases with low volatile solvents: experiments and correlation, *Fluid Phase Equilibria* 84 (1993) 143–163, doi:10.1016/0378-3812(93)85121-2.
- [165] J.L. Oscarson, J.Y. Coxam, S.E. Gillespie, R.M. Izatt, Excess enthalpies of mixing methane with methanol, n-heptane, toluene and methylcyclohexane at 255.4 and 310.9 K and 13.8 MPa, *Fluid Phase Equilibria* 114 (1996) 161–174, doi:10.1016/0378-3812(95)02813-7.
- [166] J.P. Kohn, W.F. Bradish, Multiphase and volumetric equilibria of the methane-n-octane system at temperatures between -110 and 150 C, *J. Chem. Eng. Data* 9 (1964) 5–8, doi:10.1021/je60020a003.
- [167] A. Velikovskii, G. Stepanova, *Gazov Promst* 9 (1964) 1–6.
- [168] L.M. Shipman, J.P. Kohn, Heterogeneous phase and volumetric equilibrium in the methane-n-nonane system, *J. Chem. Eng. Data* 11 (1966) 176–180, doi:10.1021/je60029a014.
- [169] P. Rousseaux, D. Richon, H. Renon, A static method for determination of vapour-liquid equilibria and saturated liquid molar volumes at high pressures and temperatures using a new variable-volume cell, *Fluid Phase Equilibria* 11 (1983) 153–168, doi:10.1016/0378-3812(83)80055-7.
- [170] K.T. Koonce, Riki. Kobayashi, A method for determining the solubility of gases in relatively nonvolatile liquids: solubility of methane in n-decane, *J. Chem. Eng. Data* 9 (1964) 490–494, doi:10.1021/je60023a004.
- [171] J.M. Beaudoin, J.P. Kohn, Multiphase and volumetric equilibria of the methane-n-decane binary system at temperatures between -36.degree, and 150.degree, *J. Chem. Eng. Data* 12 (1967) 189–191, doi:10.1021/je60033a007.
- [172] H.-M. Lin, H.M. Sebastian, J.J. Simnick, K.-C. Chao, Gas-liquid equilibrium in binary mixtures of methane with N-decane, benzene, and toluene, *J. Chem. Eng. Data* 24 (1979) 146–149, doi:10.1021/je60081a004.
- [173] H.H. Reamer, R.H. Olds, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems, *Ind. Eng. Chem.* 34 (1942) 1526–1531, doi:10.1021/ie50396a025.
- [174] M.P.W.M. Rijkers, M. Malais, C.J. Peters, J. de, S. Arons, Measurements on the phase behavior of binary hydrocarbon mixtures for modelling the condensation behavior of natural gas: part I. the system methane + decane, *Fluid Phase Equilibria* 71 (1992) 143–168, doi:10.1016/0378-3812(92)85010-6.
- [175] J. Arnaud, 1995.
- [176] M.P.W.M. Rijkers, V.B. Maduro, C.J. Peters, J. de, S. Arons, Measurements on the phase behavior of binary mixtures for modeling the condensation behavior of natural gas: Part II. The system methane + dodecane, *Fluid Phase Equilibria* 72 (1992) 309–324, doi:10.1016/0378-3812(92)85033-5.
- [177] H.-M. Lin, H.M. Sebastian, K.-C. Chao, Gas-liquid equilibrium in hydrogen + n-hexadecane and methane + n-hexadecane at elevated temperatures and pressures, *J. Chem. Eng. Data* 25 (1980) 252–254, doi:10.1021/je60086a012.
- [178] M. Glaser, C.J. Peters, H.J.V.D. Kool, R.N. Lichtenthaler, Phase equilibria of (methane + n-hexadecane) and (p, Vm, T) of n-hexadecane, *J. Chem. Thermodyn.* 17 (1985) 803–815, doi:10.1016/0021-9614(85)90072-2.
- [179] M.P.W.M. Rijkers, C.J. Peters, J. de, S. Arons, Measurements on the phase behavior of binary mixtures for modeling the condensation behavior of natural gas: Part III. The system methane + hexadecane, *Fluid Phase Equilibria* 85 (1993) 335–345, doi:10.1016/0378-3812(93)80023-G.
- [180] S.H. Huang, H.M. Lin, K.C. Chao, Solubility of carbon dioxide, methane, and ethane in n-icosane, *J. Chem. Eng. Data* 33 (1988) 145–147, doi:10.1021/je00052a026.
- [181] N.A. Darwish, J. Fathikalajahi, K.A.M. Gasem, R.L. Robinson, Solubility of methane in heavy normal paraffins at temperatures from 323 to 423 K and pressures to 10.7 MPa, *J. Chem. Eng. Data* 38 (1993) 44–48, doi:10.1021/je00009a010.
- [182] R.H. Olds, B.H. Sage, W.N. Lacey, Methane-Isobutane System, *Ind. Eng. Chem.* 34 (1942) 1008–1013, doi:10.1021/ie50392a027.
- [183] S.D. Barsuk, V.G. Skripka, O.A. Ben'yaminovich, Liquid-vapor equilibria in a methane-isobutane system at low temperatures, *Gazov Promst* 15 (1970) 38–41.
- [184] W.M. Haynes, Orthobaric liquid densities and dielectric constants of (methane+2-methyl-propane) and (methane+n-butane) at low temperatures, *J. Chem. Thermodyn.* 15 (1983) 903–911, doi:10.1016/0021-9614(83)90123-4.
- [185] E.H. Amick Jr., W.B. Johnson, B.F. Dodge, PVTX relationships for the system-methane-isopentane, *Chem Eng Prog Symp Ser.* 48 (1952) 65–72.
- [186] J.P. Kohn, J.H.S. Haggin, Low pressure vapor-liquid isotherms in the methane-3-methylpentane binary system, *J. Chem. Eng. Data* 12 (1967) 313–315, doi:10.1021/je60034a006.
- [187] B.L. Rogers, J.M. Prausnitz, High pressure vapor-liquid equilibria for argon + neopentane and methane + neopentane, *J. Chem. Thermodyn.* 3 (1971) 211–216, doi:10.1016/S0021-9614(71)80104-0.
- [188] S. Peramanu, B.B. Pruden, Solubility study for the purification of hydrogen from high pressure hydrocracker off-gas by an absorption-stripping process, *Can. J. Chem. Eng.* 75 (1997) 535–543, doi:10.1002/cjce.5450750307.
- [189] S.G. D'Avila, B.K. Kaul, J.M. Prausnitz, Solubilities of heavy hydrocarbons in compressed methane and nitrogen, *J. Chem. Eng. Data* 21 (1976) 488–491, doi:10.1021/je60071a017.
- [190] P. Uchytíl, I. Wichterle, Liquid-vapour critical region of the most volatile component of a ternary system. I. Vapour-liquid equilibria in the ethane - propane - n-butane system, *Fluid Phase Equilibria* 15 (1983) 209–217, doi:10.1016/0378-3812(83)80153-8.
- [191] D.E. Matschke, G. Thodos, Vapor-Liquid Equilibria for the Ethane-Propane System, *J. Chem. Eng. Data* 7 (1962) 232–234, doi:10.1021/je60013a022.
- [192] L. Djordjević, R.A. Budenholzer, Vapor-liquid equilibrium data for ethane-propane system at low temperatures, *J. Chem. Eng. Data* 15 (1970) 10–12, doi:10.1021/je60044a020.
- [193] J. Miksovsky, I. Wichterle, Liquid- vapor equilibrium. LXX. Vapor - liquid equilibria in the ethane - propane system at high pressures, *Collect. Czech. Chem. Commun.* 40 (1975) 365–370, doi:10.1135/cccc19750365.
- [194] C.J. Blanc, J.C.B. Setier, Vapor-liquid equilibria for the ethane-propane system at low temperature, *J. Chem. Eng. Data* 33 (1988) 111–115, doi:10.1021/je00052a015.
- [195] J.B. Ott, P.R. Brown, J.D. Moore, A.C. Lewellen, Excess molar enthalpies and excess molar volumes for (propane + ethane) over the temperature range from 273.15 K to 373.15 K and the pressure range from 5 MPa to 15 MPa, *J. Chem. Thermodyn.* 29 (1997) 149–178, doi:10.1006/jcht.1996.0144.
- [196] W.R. Adams, P. Gopal, J.A. Zollweg, W.B. Streett, Excess properties of (ethane + propane)(l) and (carbon monoxide + methane)(l), *J. Chem. Thermodyn.* 19 (1987) 39–46, doi:10.1016/0021-9614(87)90160-1.
- [197] V. Lhoták, I. Wichterle, Vapour-liquid equilibria in the ethane-n-butane system at high pressures, *Fluid Phase Equilibria* 6 (1981) 229–235, doi:10.1016/0378-3812(81)85006-6.
- [198] J.G. Dingrani, G. Thodos, Vapor-liquid equilibrium behavior of the ethane-n-butane-n-hexane system, *Can. J. Chem. Eng.* 56 (1978) 616–623, doi:10.1002/cjce.5450560516.
- [199] V.S. Mehra, G. Thodos, Vapor-Liquid Equilibrium in the Ethane-n-Butane System, *J. Chem. Eng. Data* 10 (1965) 307–309, doi:10.1021/je60027a001.
- [200] W.B. Kay, Liquid-vapor equilibrium relations in binary systems the ethane-n-butane system, *Ind. Eng. Chem.* 32 (1940) 353–357, doi:10.1021/ie50363a015.
- [201] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase equilibria in hydrocarbon systems. volumetric and phase behavior of the ethane-n-pentane system, *J. Chem. Eng. Data* 5 (1960) 44–50, doi:10.1021/je60005a012.
- [202] H.H. Reamer, V. Berry, B.H. Sage, Partial volumetric behavior in hydro-carbon systems. ethane and n-pentane in the liquid phase of the ethane-n-pentane system, *J. Chem. Eng. Data* 6 (1961) 184–191, doi:10.1021/je60010a005.
- [203] K. Ohgaki, F. Sano, T. Katayama, Isothermal vapor-liquid equilibrium data for binary systems containing ethane at high pressures, *J. Chem. Eng. Data* 21 (1976) 55–58, doi:10.1021/je60068a016.
- [204] E.J. Zais, I.H. Silberberg, Vapor-liquid equilibria in the ethane-n-hexane system, *J. Chem. Eng. Data* 15 (1970) 253–256, doi:10.1021/je60045a024.
- [205] K.A.M. Gasem, A.M. Raff, N. Darwish, R.L. Robinson, Solubility of ethane in n-hexane at pressures to 5.4 MPa and temperatures from 311 to 394 K, *J. Chem. Eng. Data* 34 (1989) 397–398, doi:10.1021/je00058a007.
- [206] S. Dastur, Dissertation, Northwestern Univ., 1964.
- [207] V.S. Mehra, G. Thodos, Vapor-liquid equilibrium in the ethane-n-heptane system, *J. Chem. Eng. Data* 10 (1965) 211–214, doi:10.1021/je60026a001.
- [208] W.B. Kay, Liquid-vapor phase equilibrium relations in the ethane-n-heptane system, *Ind. Eng. Chem.* 30 (1938) 459–465, doi:10.1021/ie50340a023.
- [209] A.B.J. Rodrigues, D.S. McCaffrey, J.P. Kohn, Heterogeneous phase and volumetric equilibria in the ethane-n-octane system, *J. Chem. Eng. Data* 13 (1968) 164–168, doi:10.1021/je60037a006.
- [210] W.L. Weng, M.J. Lee, Vapor-liquid equilibrium of the octane/carbon dioxide, octane/ethane, and octane/ethylene systems, *J. Chem. Eng. Data* 37 (1992) 213–215, doi:10.1021/je00006a020.
- [211] H.H. Reamer, B.H. Sage, Phase equilibria in hydrocarbon systems. volumetric and phase behavior of the ethane-n-decane system, *J. Chem. Eng. Data* 7 (1962) 161–168, doi:10.1021/je60013a001.
- [212] B.A. Bufkin, R.L. Robinson, S.S. Estrera, K.D. Luks, Solubility of ethane in n-decane at pressures to 8.2 MPa and temperatures from 278 to 411 K, *J. Chem. Eng. Data* 31 (1986) 421–423, doi:10.1021/je00046a015.
- [213] H. Gardeler, K. Fischer, J. Gmehling, Experimental determination of vapor-liquid equilibrium data for asymmetric systems, *Ind. Eng. Chem. Res.* 41 (2002) 1051–1056, doi:10.1021/ie0103456.
- [214] S.S. Estrera, M.M. Arbuckle, K.D. Luks, Solubility and partial miscibility of ethane in certain hydrocarbon liquids, *Fluid Phase Equilibria* 35 (1987) 291–307, doi:10.1016/0378-3812(87)80018-3.
- [215] K.A.M. Gasem, R.L. Robinson, Solubilities of carbon dioxide in heavy normal paraffins (C20-C44) at pressures to 9.6 MPa and temperatures from 323 to 423 K, *J. Chem. Eng. Data* 30 (1985) 53–56, doi:10.1021/je00039a018.
- [216] K.H. Lee, J.P. Kohn, Heterogeneous phase equilibrium in the ethane-n-dodecane system, *J. Chem. Eng. Data* 14 (1969) 292–295, doi:10.1021/je60042a021.
- [217] M. Meskel-Lesavre, D. Richon, H. Renon, New variable volume cell for determining vapor-liquid equilibria and saturated liquid molar volumes by the static method, *Ind. Eng. Chem. Fundam.* 20 (1981) 284–289, doi:10.1021/i100003a017.
- [218] D. Legret, D. Richon, H. Renon, Static still for measuring vapor-liquid equilibria up to 50 bar, *Ind. Eng. Chem. Fundam.* 19 (1980) 122–126, doi:10.1021/i160073a021.
- [219] K.A.M. Gasem, B.A. Bufkin, A.M. Raff, R.L. Robinson, Solubilities of ethane in heavy normal paraffins at pressures to 7.8 MPa and temperatures from 348 to 423 K, *J. Chem. Eng. Data* 34 (1989) 187–191, doi:10.1021/je00056a012.
- [220] C.J. Peters, J.L. De Roo, R.N. Lichtenthaler, Measurements and calculations of phase equilibria of binary mixtures of ethane + eicosane. Part I: vapour + liquid equilibria, *Fluid Phase Equilibria* 34 (1987) 287–308, doi:10.1016/0378-3812(87)80037-7.

- [221] G.J. Besserer, D.B. Robinson, Equilibrium-phase properties of isobutane-ethane system, *J. Chem. Eng. Data*. 18 (1973) 301–304, doi:10.1021/je60058a003.
- [222] G. Kaminishi, C. Yokoyama, S. Takahashi, Vapor pressures of n-butane-ethane, isobutane-ethane, and n-butane-isobutane-propane-ethane systems, *Sekiyu Gakkaishi* 29 (1986) 32–37.
- [223] T.W. De Loos, H.J. Van der Kooij, P.L. Ott, Vapor-liquid critical curve of the system ethane + 2-methylpropane, *J. Chem. Eng. Data*. 31 (1986) 166–168, doi:10.1021/je00044a011.
- [224] Y. Kobatake, J.H. Hildebrand, Solubility and entropy of solution of He, N<sub>2</sub>, A, O<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, CO<sub>2</sub> AND SF<sub>6</sub> in various solvents; regularity of gas solubilities, *J. Phys. Chem.* 65 (1961) 331–335, doi:10.1021/j100820a036.
- [225] F. Fallaha, Ph.D. thesis, University of Birmingham, 1974.
- [226] M. López, M.L.P. Andrade, J.L. Legido, L. Romani, J. Peleteiro, E. Jiménez, Excess molar enthalpies for the (ethyl propanoate + n-hexane + n-tetradecane) system at the temperature 298.15 K, *Phys. Chem. Liq.* 25 (1993) 145–152, doi:10.1080/00319109308030356.
- [227] Z. Wang, Y. Horikawa, G.C. Benson, B.C. Lu, Excess enthalpies of the ternary mixtures: ethyl tert-butylether + n-heptane + (n-decane or n-dodecane) at 298.15 K, *Can. J. Chem.* 79 (2001) 388–393, doi:10.1139/v01-064.
- [228] G.W. Lundberg, Thermodynamics of solutions XI. heats of mixing of hydrocarbons, *J. Chem. Eng. Data*. 9 (1964) 193–198, doi:10.1021/je60021a013.
- [229] S.E.M. Hamam, M.K. Kumaran, G.C. Benson, Excess enthalpies and excess volumes of each of the mixtures: (n-dodecane + an isomer of hexane) at 298.15 K, *J. Chem. Thermodyn.* 16 (1984) 537–542, doi:10.1016/0021-9614(84)90004-1.
- [230] S.E.M. Hamam, G.C. Benson, Excess enthalpies of some binary mixtures of hexane isomers, *J. Chem. Thermodyn.* 18 (1986) 591–594, doi:10.1016/0021-9614(86)90144-8.
- [231] V. Mathot, Propriétés thermodynamiques de solutions d'hydrocarbures isomères: influence de la Symétrie Moléculaire Des Constituants, *Bull. Sociétés Chim. Belg.* 59 (1950) 111–136, doi:10.1002/bscb.19500590302.
- [232] D.-Y. Peng, Y. Horikawa, Z. Wang, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of 2,2,4-trimethylpentane + n-alkane binary mixtures at 298.15 K, *J. Chem. Eng. Data*. 46 (2001) 237–238, doi:10.1021/je000320y.
- [233] E.C. Bromiley, D. Quiggle, Vapor-liquid equilibria of hydrocarbon mixtures, *Ind. Eng. Chem.* 25 (1933) 1136–1138, doi:10.1021/ie50286a019.
- [234] L. Sieg, Flüssigkeit-Dampf-Gleichgewichte in binären Systemen von Kohlenwasserstoffen verschiedenen Typs, *Chem. Ing. Tech.* 22 (1950) 322–326, doi:10.1002/cite.330221503.
- [235] W. Mier, G. Oswald, E. Tusel-Langer, R.N. Lichtenthaler, Excess enthalpy of binary mixtures containing alkanes, ethanol and ethyl-tert. butyl ether (ETBE), *Berichte Bunsenges. Für Phys. Chem.* 99 (1995) 1123–1130, doi:10.1002/bbpc.199500043.
- [236] W. Mier, R.N. Lichtenthaler, A.H. Roux, J.-P.E. Grolier, Excess molar heat capacities C<sub>EP,m</sub> and excess molar volumes V<sub>EM</sub> of {x1CH<sub>3</sub>(CH<sub>2</sub>)<sub>5</sub>CH<sub>3</sub> + x2CH<sub>3</sub>C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)CH<sub>3</sub> + x3CH<sub>3</sub>C(CH<sub>3</sub>)<sub>2</sub>OC<sub>2</sub>H<sub>5</sub> + (1 - x<sub>1</sub> - x<sub>2</sub> - x<sub>3</sub>)C<sub>2</sub>H<sub>5</sub>OH}(l) I. Binary and quaternary mixtures, *J. Chem. Thermodyn.* 26 (1994) 1323–1334, doi:10.1006/jcht.1994.1151.
- [237] H. Bendjab, G. Roux-Desgranges, A.H. Roux, J.-P.E. Grolier, D. Patterson, Excess heat capacities of ternary systems containing chlorobenzene or chloronaphthalene, *J. Solut. Chem.* 23 (1994) 307–323, doi:10.1007/bf00973552.
- [238] D.-Y. Peng, G.C. Benson, B.C.-Y. Lu, Excess Enthalpies of 2,2,4-Trimethylpentane + Hexane + (Octane or Dodecane) at 298.15 K, *J. Chem. Eng. Data*. 45 (2000) 48–52, doi:10.1021/je990197e.
- [239] J.W. Glanville, B.H. Sage, W.N. Lacey, Volumetric and phase behavior of propane-benzene system, *Ind. Eng. Chem.* 42 (1950) 508–513, doi:10.1021/ie50483a030.
- [240] D. Fleury, W. Hayduk, Solubility of propane in isomers of hexane and other non-polar solvents, *Can. J. Chem. Eng.* 53 (1975) 195–199, doi:10.1002/cjce.5450530207.
- [241] M. Hirata, *International Symposium, Warszawa-Jablona* (1975).
- [242] Y. Miyano, W. Hayduk, Solubilities of butane, vapor pressures, and densities for benzene + cyclohexane, benzene + methanol, and methanol + cyclohexane solutions at 298 K, *J. Chem. Eng. Data*. 38 (1993) 277–281, doi:10.1021/je00010a024.
- [243] Y. Miyano, W. Hayduk, Solubility of butane in several polar and nonpolar solvents and in an acetone-butanol solvent solution, *J. Chem. Eng. Data*. 31 (1986) 77–80, doi:10.1021/je00043a022.
- [244] J.L.H. Wang, B.C.-Y. Lu, Vapor-liquid equilibrium data for the n-pentane-benzene system, *J. Appl. Chem. Biotechnol.* 21 (1971) 297–299, doi:10.1002/jctb.5020211006.
- [245] W.W. Bowden, J.C. Station, B.D. Smith, Vapor-liquid-liquid equilibrium of the n-pentane-sulfur dioxide-benzene system at 0°F, *J. Chem. Eng. Data*. 11 (1966) 296–303, doi:10.1021/je60030a004.
- [246] H.S. Myers, Vapor-liquid equilibrium data for binary mixtures of paraffins and aromatics, *Ind. Eng. Chem.* 47 (1955) 2215–2219, doi:10.1021/ie50550a050.
- [247] L. Wang, *Nengyuan Jikan* 11 (1981) 8–39.
- [248] M. Diaz Peña, C. Mendiña, Excess enthalpies at 298.15 K of binary mixtures of benzene with n-alkanes, *J. Chem. Thermodyn.* 6 (1974) 387–393, doi:10.1016/0021-9614(74)90169-4.
- [249] H.K.D. Jones, D.P.L. Poon, R.F. Lama, B.C.-Y. Lu, Heats of mixing of liquids: application of Quasi-lattice theory to Benziene-n-Alkane systems, *Can. J. Chem. Eng.* 45 (1967) 22–24, doi:10.1002/cjce.5450450105.
- [250] E.L. Meijer, N. Brouwer, J.C. Van Miltenburg, Vapour pressures and excess Gibbs energy of the liquid mixture carbon tetrachloride + 1,1,1-trichloroethane, *J. Chem. Thermodyn.* 8 (1976) 703–708, doi:10.1016/0021-9614(76)90049-5.
- [251] R.S. Murray, M.L. Martin, A continuous-dilution device for the measurement of static vapour pressures of binary liquid mixtures, *J. Chem. Thermodyn.* 7 (1975) 839–846, doi:10.1016/0021-9614(75)90092-0.
- [252] V.C. Smith, R.L. Robinson, Vapor-liquid equilibria at 25 deg. in the binary mixtures formed by hexane, benzene, and ethanol, *J. Chem. Eng. Data*. 15 (1970) 391–395, doi:10.1021/je60046a005.
- [253] D. Jain, V. Gupta, *Indian J. Chem.* 8 (1970) 815–820.
- [254] K.S. Yuan, J.C.K. Ho, A.K. Koshpande, B.C.-Y. Lu, Vapor-liquid equilibria, *J. Chem. Eng. Data*. 8 (1963) 549–559, doi:10.1021/je60019a024.
- [255] I.P.C. Li, Y.-W. Wong, S.-D. Chang, B.C.Y. Lu, Vapor-liquid equilibria in systems n-hexane-benzene and n-pentane-toluene, *J. Chem. Eng. Data*. 17 (1972) 492–498, doi:10.1021/je60055a037.
- [256] N.P. Markuzin, V.F. Plekhotkin, Concerning the existence of solutropism in the ethylenediamine-benzene-normal-hexane system, *Zh. Fiz. Khim.* 36 (1962) 1973–1978.
- [257] M. Susarev, S. Chen, *Zh. Fiz. Khim.* 37 (1963) 1739–1744.
- [258] C. Saez, A. Compostizo, R.G. Rubio, A. Crespo Colin, M. Díaz Peña, p, T, x, y data of benzene + n-hexane and cyclohexane + n-heptane systems, *Fluid Phase Equilibria* 24 (1985) 241–258, doi:10.1016/0378-3812(85)85006-8.
- [259] M. Góral, Vapour-liquid equilibria in non-polar mixtures. III. binary mixtures of alkylbenzenes and n-alkanes at 313.15 K, *Fluid Phase Equilibria* 102 (1994) 275–286, doi:10.1016/0378-3812(94)87080-2.
- [260] C.O. Tongberg, F. Johnston, Vapor-liquid equilibria for n-hexane-benzene mixtures, *Ind. Eng. Chem.* 25 (1933) 733–735, doi:10.1021/ie50283a006.
- [261] F. Gothard, I. Minea, *Rev Chim Buchar* 11 (1960) 705–708.
- [262] K. Ridgway, P.A. Butler, Physical properties of the ternary system benzene-cyclohexane-hexane, *J. Chem. Eng. Data*. 12 (1967) 509–515, doi:10.1021/je60035a012.
- [263] D.O. Hanson, M. Van Winkle, Alteration of the relative volatility of hexane-1-hexene by oxygenated and chlorinated solvents, *J. Chem. Eng. Data*. 12 (1967) 319–325, doi:10.1021/je60034a009.
- [264] W. Brzostowski, Vapour-liquid equilibria in the benzene+ hexane system containing carbon 1 4-labelled benzene, *Bull Acad Pol. Sci Ser Sci Chim.* 9 (1961) 471–475.
- [265] P.S. Prabhu, M. Van Winkle, Effect of polar components on the relative volatility of the binary system n-hexane-benzene, *J. Chem. Eng. Data*. 8 (1963) 210–214, doi:10.1021/je60017a022.
- [266] S. Saito, Separation of hydrocarbons. 2. vapor- liquid equilibria of normal paraffin- aromatic systems, *Asahi Garasu Kogyo Gijutsu Shoreikai Kenkyu Hokoku* 15 (1969) 397–407.
- [267] Z. Gu, J. Lin, L. Si, Measurement and correlation of hexane-methylcyclopentane- dibutyl-o-phthalate vapor-liquid equilibrium data, *Huaxue Gongye Yu Gongcheng* 1 (1999) 39–43.
- [268] F. Gothard, I. Minea, Vapor-liquid equilibrium of hexane-benzene mixtures at low pressure, *Rev. Chim. Buchar.* 14 (1963) 520–525.
- [269] J. Surovy, J. Dojcansky, M. Revus, V. Marecek, Effect of N-methylpyrrolidone on relative volatility of n-hexane-benzene system, *Ropa Uhlie* 22 (1980) 236–243.
- [270] Z. Chen, J. Tang, *DIPPR Data Ser* 1 (1991) 24–31.
- [271] W. Beyer, H. Schuberth, E. Leibnitz, Untersuchungen über das Dampf-Flüssigkeits-Phasengleichgewicht des Systems n-Hexan/Methylcyclopentan/Benzol bei 60°C unter Verwendung einer gaschromatographischen Analysemmethode, *J. Für Prakt. Chem.* 27 (1965) 276–296, doi:10.1002/prac.19650270507.
- [272] W.B. Kay, D. Hissong, The critical properties of hydrocarbons I. simple mixtures, *Proc. Am. Pet. Inst. Div. Refin.* 47 (1967) 653–722.
- [273] M. Andrade, M. Regueiro, M. Baluja, E. Jimenez, C. Hernandez, Heats of mixing at mean temperatures. hexane-benzene system, *Acta Cient Compostel* 7 (1970) 147–152.
- [274] M. Diaz Peña, C. Mendiña, Excess enthalpies at 323.15 K of binary mixtures of benzene with n-alkanes, *J. Chem. Thermodyn.* 6 (1974) 1097–1102, doi:10.1016/0021-9614(74)90072-X.
- [275] H.K.DeQ. Jones, B.C.-Y. Lu, Heats of mixing of liquids for the system ethanol-benzene-n-hexane, *J. Chem. Eng. Data*. 11 (1966) 488–492, doi:10.1021/je60031a009.
- [276] M.I. Paz Andrade, Thermodynamic properties of binary mixtures. I. heat of mixing, *Acta Cient Compostel* 1 (1964) 117–130.
- [277] L. Romani, M.I. Paz Andrade, Thermodynamic excess functions at 25 C. III. benzene + isomers of hexane, *Quim* 70 (1974) 422–425.
- [278] C.-A. Hwang, A.S. Elkabule, D.L. Whitman, R.C. Miller, Excess molar enthalpies of (benzene + cyclohexane + n-hexane), *J. Chem. Thermodyn.* 19 (1987) 1031–1036, doi:10.1016/0021-9614(87)90013-9.
- [279] E. Baud, Thermal analysis of binary mixtures, *Bull. Soc. Chim. Fr.* 17 (1915) 329–345.
- [280] H. Pahlke, Thesis, Christian-Albrechts-Universitaet, 1935.
- [281] H. Casas, L. Segade, C. Franjo, E. Jiménez, M.I. Paz Andrade, Excess molar enthalpies of propyl propanoate + hexane + benzene at 298.15 K and 308.15 K, *J. Chem. Eng. Data*. 45 (2000) 445–449, doi:10.1021/je990265x.
- [282] M.M. Mato, J. Balseiro, E. Jiménez, J.L. Legido, A.V. Galiñanes, M.I. Paz Andrade, Excess molar enthalpies and excess molar volumes of the ternary system 1,2-dichlorobenzene + benzene + hexane at 298.15 K, *J. Chem. Eng. Data*. 47 (2002) 1436–1441, doi:10.1021/je025535h.



- [283] M. Costas, D. Patterson, Excess heat capacity. Benzene-hexane system, *Int DATA Ser Sel Data Mix. Ser. A.* (1985) 212–223.
- [284] K.L. Butcher, K.R. Ramasubramanian, M.S. Medani, Thermodynamic properties of the benzene and n-heptane system at elevated temperatures, *J. Appl. Chem. Biotechnol.* 22 (1972) 1139–1155, doi:10.1002/jctb.5020221103.
- [285] A. Danneil, K. Tödheide, E.U. Franck, Verdampfungsgleichgewichte und kritische Kurven in den Systemen Äthan/Wasser und n-Butan/Wasser bei hohen Drücken, *Chem. Ing. Tech.* 39 (1967) 816–822, doi:10.1002/cite.330391309.
- [286] J. Heinrich, Activity coefficients in binary systems of perfectly miscible components, *Collect. Czechoslov. Chem. Commun.* 40 (1975) 787–793, doi:10.1135/cccc19750787.
- [287] K.R. Harris, P.J. Dunlop, Vapour pressures and excess Gibbs energies of mixtures of benzene with chlorobenzene, n-hexane, and n-heptane at 25°C, *J. Chem. Thermodyn.* 2 (1970) 805–811, doi:10.1016/0021-9614(70)90023-6.
- [288] G. Werner, H. Schuberth, Das phasengleichgewicht flüssig-flüssig des systems benzol/n-heptan/acetonnitril sowie die phasengleichgewichte dampfförmig-flüssig der entsprechenden binären systeme bei 20,0 °C, *J. Für Prakt. Chem.* 31 (1966) 225–239, doi:10.1002/prac.19660310501.
- [289] D.V.S. Jain, V.K. Gupta, B.S. Lark, Thermodynamics of n-alkane mixtures V. vapour pressures and excess Gibbs energies of n-heptane+benzene and n-octane+benzene, *J. Chem. Thermodyn.* 5 (1973) 451–454, doi:10.1016/S0021-9614(73)80036-9.
- [290] U. Messow, D. Schuetze, R. Pfestorf, D. Kuchenbecker, K. Suehnel, Thermodynamic studies on solvent/n-paraffin systems. III. the benzene/n-heptane and benzene/n-decane system, *Z Phys Chem Leipzig* 258 (1977) 24–32.
- [291] I. Brown, Liquid-vapour equilibria. III. the systems benzene-n-heptane, n-hexane-chlorobenzene, and cyclohexane-nitrobenzene, *Aust. J. Chem.* 5 (1952) 530–540, doi:10.1071/ch9520530.
- [292] S.J. Fu, B.C.-Y. Lu, Binary vapour-liquid equilibria, *J. Appl. Chem.* 16 (1966) 324–326, doi:10.1002/jctb.5010161103.
- [293] I. Brown, A.H. Ewald, Liquid-vapour equilibria. II. the system benzene-n-heptane, *Aust. J. Chem.* 4 (1951) 198–212, doi:10.1071/ch9510198.
- [294] T. Treszczanowicz, H. Kehiaian, *Bull. Acad. Pol. Sci. Ser. Sci. Chim.* 21 (1973) 97–105.
- [295] B. Wiśniewska, J. Gregorowicz, S. Malanowski, Development of a vapour-liquid equilibrium apparatus to work at pressures up to 3 MPa, *Fluid Phase Equilibria* 86 (1993) 173–186, doi:10.1016/0378-3812(93)87174-Y.
- [296] B. Loiseau, *Bull. Soc. Chim. Fr.* 11 (1968) 4390–4398.
- [297] K. Hloušek, E. Hála, Liquid-vapour equilibrium. XLIII. the system benzene-n-heptane at 720, 740, and 760 mm Hg, *Collect. Czechoslov. Chem. Commun.* 35 (1970) 1030–1040, doi:10.1135/cccc19701030.
- [298] T. Michishita, Y. Arai, S. Saito, Vapor-liquid equilibria of hydrocarbons at atmospheric pressure, *Kagaku Kogaku* 35 (1971) 111–116.
- [299] R.L. Nielsen, J.H. Weber, Vapor-liquid equilibria at subatmospheric pressures. binary and ternary systems containing ethyl alcohol, benzene, and n-heptane, *J. Chem. Eng. Data.* 4 (1959) 145–151, doi:10.1021/je60002a011.
- [300] S. Ellis, A new equilibrium still and binary equilibrium data, *Trans. Inst. Chem. Eng.* 30 (1952) 58–64.
- [301] R.P. Tripathi, L. Asselineau, Isobaric vapor-liquid equilibria in ternary system benzene-n-heptane-acetonitrile from binary t-x measurements, *J. Chem. Eng. Data.* 20 (1975) 33–40, doi:10.1021/je60064a007.
- [302] L.M. Lozano, E.A. Montero, M.C. Martín, M.A. Villamañán, Isothermal vapor-liquid equilibria of binary mixtures containing methyl tert-butyl ether (MTBE) and/or substitution hydrocarbons, *Fluid Phase Equilibria* 133 (1997) 155–162, doi:10.1016/S0378-3812(97)00010-1.
- [303] J.J. Segovia, M.C. Martín, C.R. Chamorro, M.A. Villamañán, Thermodynamics of octane-enhancing additives in gasolines: vapor-liquid equilibrium of the ternary mixtures methyl tert-butyl ether+heptane+benzene and methyl tert-butyl ether+benzene+1-hexene at 313.15 K, *J. Chem. Eng. Data.* 43 (1998) 1014–1020, doi:10.1021/je980107q.
- [304] N. Yarym-Agaev, V. Kalinichenko, *Zh. Prikl. Khim.* 55 (1982) 2612–2614.
- [305] Y. Sun, W.H. Yen, Vapor pressures and excess gibbs free energies of benzene-cyclohexane, benzene-n-heptane and cyclohexane-n-heptane, *Gaodeng Xuexiao Huaxue Xuebao* 7 (1986) 54–58.
- [306] Z. Cui, J. Li, A new type vapor-liquid equilibrium still, *Shiyu Huagong* 15 (1986) 528–531.
- [307] Q. Wang, G. Chen, S. Han, Study on the vapor-liquid equilibria under pressure for binary systems, *Ranliao Huaxue Xuebao* (1990) 185–192.
- [308] D.A. Palmer, B.D. Smith, Thermodynamic excess property measurements for acetonitrile-benzene-n-heptane system at 45 deg, *J. Chem. Eng. Data.* 17 (1972) 71–76, doi:10.1021/je60052a037.
- [309] I. Hammerl, M.T. Raetzsch, Enthalpies of mixing of normal paraffins with aromatics, *Wiss Z Tech Hochsch Chem Leuna-Mersebg* 15 (1973) 175–178.
- [310] B.C.-Y. Lu, H.K.D. Jones, Extrapolation of ternary excess thermodynamic properties, *Can. J. Chem. Eng.* 44 (1966) 251–254, doi:10.1002/cjce.5450440502.
- [311] D. Kuchenbecker, 1980.
- [312] J.W. Bayles, T.M. Letcher, Thermodynamics of some binary liquid mixtures containing aliphatic amines, *J. Chem. Eng. Data.* 16 (1971) 266–271, doi:10.1021/je60050a026.
- [313] E. Münch, Mischungskalorimetrie mit einem verdrängungskalorimeter, dargestellt an den systemen benzol+n-heptan, 2-methylnaphthalin+1-methylnaphthalin, toluol+chlorbenzol und chlorbenzol+äthylbenzol, *Thermochim. Acta.* 22 (1978) 237–255, doi:10.1016/0040-6031(78)85090-4.
- [314] W. Renker, *Priv. Commun.* (1969).
- [315] C.P. Brown, A.R. Mathieson, J.C.J. Thynne, Thermodynamics of hydrocarbon mixtures. part I. the heats of mixing of the binary and ternary systems formed by benzene, cyclohexane, and n-heptane, *J. Chem. Soc. Resumed.* (1955) 4141–4146, doi:10.1039/JR9550004141.
- [316] J.R. Battler, R.L. Rowley, Excess enthalpies between 293 and 323 K for constituent binaries of ternary mixtures exhibiting partial miscibility, *J. Chem. Thermodyn.* 17 (1985) 719–732, doi:10.1016/0021-9614(85)90101-6.
- [317] R. Vilcu, F. Stanciu, Excess thermodynamic functions from calorimetric data, *Rev. Roum. Chim.* 11 (1966) 175–182.
- [318] V. Timofeev, The Heat of Formation in Non-Aqueous Solutions, *Monograph "O teplotie obrazovaniya nevodnykh rastvorov."*, Kiev (1904) 91–183.
- [319] H. Ogawa, S. Murakami, T. Takigawa, M. Ohba, Thermodynamic properties of rigid polycyclic molecules. 1: enthalpies of solution of fused ring polycyclic aromatic hydrocarbons, *Fluid Phase Equilibria* 136 (1997) 279–287, doi:10.1016/S0378-3812(97)00134-9.
- [320] R. Tanaka, Excess heat capacities for mixture of benzene with n-heptane at 293.15, 298.15, and 303.15 K, *J. Chem. Eng. Data.* 32 (1987) 176–177, doi:10.1021/je00048a014.
- [321] M.H. Karbalai Ghassemi, J. Grolier, Excess heat capacity. cyclohexane-n-hexane system, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1976) 95–96.
- [322] I.M. Elshayal, B.C.-Y. Lu, Isothermal vapour-liquid equilibria for the binary system benzene-n-octane, *J. Appl. Chem.* 18 (1968) 277–280, doi:10.1002/jctb.5010180905.
- [323] O.P. Yadav, Excess enthalpies of binary mixtures of some hydrocarbons, *J. Indian Chem. Soc.* 68 (1991) 596–599.
- [324] H. Sifaoui, A. Ait-kaci, H. Benmakhlouf, Chaleurs de melanges a 303,15 k des systèmes ternaires: piperidine(1)+benzène(2)+cyclohexane(3) et piperidine(1)+benzène(2)+n-octane(3), *J. Therm. Anal. Calorim.* 60 (2000) 427–436, doi:10.1023/A:1010189309287.
- [325] S.C. Pak, W.B. Kay, The critical properties of binary hydrocarbon systems, *Ind. Eng. Chem. Fundam.* 11 (1972) 255–267, doi:10.1021/i160042a018.
- [326] R.G. Rubio, J.A.R. Renuncio, M.Diaz Peña, Vapor-liquid equilibrium measurements on benzene+n-decane systems at 298.15 and 323.15 K, *Int. J. Thermophys.* 3 (1982) 325–334, doi:10.1007/BF00502348.
- [327] van Pham, *PhD Diss. Leipzig.* (1983).
- [328] U. Messow, D. Schütze, R. Pfestorf, D. Kuchenbecker, K. Sühnel, Thermodynamische Untersuchungen an Lösungsmittel/n-Paraffin-Systemen, *Z. Für Phys. Chem.* (1977) 258, doi:10.1515/zpch-1977-25807.
- [329] U. Messow, K. Quitzsch, Thermodynamics of solvent+paraffin systems, *Z. Phys. Chem. Leipzig* 257 (1976) 121–128.
- [330] R.G. Rubio, J.A.R. Renuncio, M.Diaz Peña, Excess magnitudes for the benzene+n-dodecane system at 298.15 and 323.15 K, *Thermochim. Acta.* 65 (1983) 69–79, doi:10.1016/0040-6031(83)80009-4.
- [331] U. Messow, D. Schuetze, W. Hauthal, *Z Phys Chem Leipzig* 257 (1976) 218–228.
- [332] R.L. Snow, J.B. Ott, J.R. Goates, K.N. Marsh, S. O'Shea, R.H. Stokes, Solid+liquid and (vapor+liquid) phase equilibria and excess enthalpies for (benzene+n-tetradecane), (benzene+n-hexadecane), (cyclohexane+n-tetradecane), and (cyclohexane+n-hexadecane) at 293.15, 298.15, and 308.15 K. Comparison of GmE calculated from (vapor+liquid) and (solid+liquid) equilibria, *J. Chem. Thermodyn.* 18 (1986) 107–130, doi:10.1016/0021-9614(86)90126-6.
- [333] R.G. Rubio, J.A.R. Renuncio, M.Diaz Peña, Vapor-liquid equilibria for tetradecane-benzene mixtures at 25 and 50°C, *J. Solut. Chem.* 11 (1982) 823–830, doi:10.1007/BF00650521.
- [334] I. Mokbel, A. Blondel-Telouk, D. Vellut, J. Jose, Vapor-liquid equilibria of two binary mixtures: benzene+n-tetradecane and benzene+squalane, *Fluid Phase Equilibria* 149 (1998) 287–308, doi:10.1016/S0378-3812(98)00271-4.
- [335] J. Grolier, A. Faradjzadeh, Excess heat capacity. Benzene-tetradecane system, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1979) 131–141.
- [336] R.G. Rubio, J.A.R. Renuncio, M.Diaz Peña, Excess Gibbs energies of (benzene+n-pentadecane) at 298.15 and 323.15 K, *J. Chem. Thermodyn.* 14 (1982) 983–989, doi:10.1016/0021-9614(82)90008-8.
- [337] D.V.S. Jain, B.S. Lark, Thermodynamics of n-alkane mixtures VI. Vapour pressures and excess Gibbs energies of mixtures of n-hexadecane+benzene and +carbon tetrachloride, *J. Chem. Thermodyn.* 5 (1973) 455–457, doi:10.1016/S0021-9614(73)80037-0.
- [338] M. Diaz-Peña, J.A.R. Renuncio, R.G. Rubio, Excess gibbs energies for the benzene+n-hexadecane system at 298.15 and 323.15 K, *Thermochim. Acta.* 56 (1982) 199–208, doi:10.1016/0040-6031(82)85139-3.
- [339] R.W. Stephenson, M. Van Winkle, Modification of relative volatilities by addition of solvent, *J. Chem. Eng. Data.* 7 (1962) 510–516, doi:10.1021/je60015a021.
- [340] M.R. Cines, F.N. Ruehlen, Selective Adsorption—Benzene-2,4-Dimethylpentane—Silica Gel at 65.6°, *J. Phys. Chem.* 57 (1953) 710–714, doi:10.1021/j150508a026.
- [341] B.G. Kyle, N.J. Tetlow, Perfluorotributylamine as an Extractive Distillation Solvent for a Hydrocarbon Mixture, *J. Chem. Eng. Data.* 5 (1960) 275–278, doi:10.1021/je60007a011.
- [342] E.W. Funk, F.-C. Chai, J.M. Prausnitz, Thermodynamic properties of binary liquid mixtures containing aromatic and saturated hydrocarbons, *J. Chem. Eng. Data.* 17 (1972) 24–27, doi:10.1021/je60052a032.
- [343] J. Grolier, A. Faradjzadeh, Excess volume. Benzene - 2,3-dimethylbutane system, *Int DATA Ser Sel Data Mix. Ser. A.* (1981) 30–38.
- [344] E. Wilhelm, A. Faradjzadeh, J.-P.E. Grolier, Excess volumes and excess heat capacities of 2,3-dimethylbutane+benzene and +toluene, *J. Chem. Thermodyn.* 14 (1982) 1199–1200, doi:10.1016/0021-9614(82)90045-3.

- [345] R. Wohland, S. Stoeck, *FIZ Rep.* (1974) 12121.
- [346] M. Lubomska, S.K. Malanowski, Vapor-liquid equilibrium for benzene + 2-methylpentane and allyl alcohol + 1-propanol, *J. Chem. Eng. Data.* 49 (2004) 1488–1493, doi:10.1021/je0499519.
- [347] J.M. Harrison, L. Berg, Vapor-Liquid Equilibria of Binary Hydrocarbon Systems, *Ind. Eng. Chem.* 38 (1946) 117–120, doi:10.1021/ie50433a042.
- [348] S. Weissman, S.E. Wood, Vapor-Liquid Equilibrium of Benzene-2,2,4-Trimethylpentane Mixtures, *J. Chem. Phys.* 32 (1960) 1153–1160, doi:10.1063/1.1730865.
- [349] J. Chu, S. Wang, S. Levy, R. Paul, Vapor-liquid equilibria data collection, *DECHEMA* (1980).
- [350] J.W. Kenny, Prediction of ternary liquid-liquid equilibrium from binary data: (for the system furfural-iso-octane-benzene), *Chem. Eng. Sci.* 6 (1957) 116–122, doi:10.1016/0009-2509(57)85004-0.
- [351] M. Góral, N. Asmanova, Vapor-liquid equilibria in nonpolar mixtures: Part I. 2,2,4-trimethylpentane with benzene, toluene, o-xylene, p-xylene, ethylbenzene and propylbenzene at 313.15 K, *Fluid Phase Equilibria.* 86 (1993) 201–209, doi:10.1016/0378-3812(93)87176-2.
- [352] H. Segura, J. Wisniak, G. Galindo, R. Reich, Phase equilibria in the systems ethyl 1,1-dimethylethyl ether + benzene + 2,2,4-trimethylpentane and benzene + 2,2,4-trimethylpentane at 94.00 kPa, *Phys. Chem. Liq.* 39 (2001) 637–654, doi:10.1080/00319100108030683.
- [353] H.W. Prengle, F.L. Worley, C.E. Mauk, Thermodynamics of solutions: new equipment for measuring heats of solution data for five systems, *J. Chem. Eng. Data.* 6 (1961) 395–399, doi:10.1021/je00103a023.
- [354] A. Iguchi, Excess molal specific heat of nonelectrolyte solutions, *Kagaku Sochi* 19 (1977) 64–65.
- [355] E. Rajagopal, S.V. Subrahmanyam, Excess functions VE,  $(\partial VE/\partial p)_T$ , and CpE of isoctane + benzene and + toluene, *J. Chem. Thermodyn.* 6 (1974) 873–876, doi:10.1016/0021-9614(74)90231-6.
- [356] J.-L. Fortier, G.C. Benson, Excess heat capacities of binary liquid mixtures determined with a Picker flow calorimeter, *J. Chem. Thermodyn.* 8 (1976) 411–423, doi:10.1016/0021-9614(76)90061-6.
- [357] V. Mathot, A. Desmyter, Application of the cell method to the statistical thermodynamics of solutions. ii. experimental, *J. Chem. Phys.* 21 (1953) 782–788, doi:10.1063/1.1699033.
- [358] E.P. Schoch, A.E. Hoffmann, A.S. Kasperik, J.H. Lightfoot, F.D. Mayfield, Solubility of Methane in Benzene, *Ind. Eng. Chem.* 32 (1940) 788–791, doi:10.1021/ie50366a012.
- [359] C.R. Coan, A.D. King, Second cross virial coefficients of benzene-gas mixtures from high pressure solubility measurements: A comparison with gas chromatographic values, *J. Chromatogr. A.* 44 (1969) 429–436, doi:10.1016/S0021-9673(01)92566-X.
- [360] M. Elbishlawi, J.R. Spencer, Equilibrium relations of two methane-aromatic binary systems at 150°F, *Ind. Eng. Chem.* 43 (1951) 1811–1815, doi:10.1021/ie50500a036.
- [361] D. Legret, D. Richon, H. Renon, Vapor-liquid equilibrium of methane-benzene, methane-methylbenzene (toluene), methane-1,3-dimethylbenzene (m-xylene), and methane-1,3,5-trimethylbenzene (mesitylene) at 313.2 K up to the critical point, *J. Chem. Eng. Data.* 27 (1982) 165–169, doi:10.1021/je00028a020.
- [362] N.A. Darwish, K.A.M. Gasem, R.L.Jr. Robinson, Solubility of Methane in Benzene, Naphthalene, Phenanthrene, and Pyrene at Temperatures from 323 to 433 K and Pressures to 11.3 MPa, *J. Chem. Eng. Data.* 39 (1994) 781–784, doi:10.1021/je00016a032.
- [363] S. Sage, D.C. Webster, W.N. Lacey, Phase equilibria in hydrocarbon systems. XVI. Solubility of methane in four light hydrocarbons, *Ind Eng Chem* 28 (1936) 1045–1047.
- [364] M.P.W.M. Rijkers, M. Malais, C.J. Peters, J. de Swaan Arons, Experimental determination of the phase behavior of binary mixtures of methane + benzene: Part I. Vapor + liquid, solid benzene + liquid, solid benzene + vapor and solid benzene + liquid + vapor equilibria, *Fluid Phase Equilibria* 77 (1992) 327–342, doi:10.1016/0378-3812(92)85112-L.
- [365] G.S. Stepanova, Y.I. Vybortnova, A.S. Velikovskii, Experimental study of phase equilibria of methane-n-hexane-benzene ternary system, *Gaz Delo Nauchn Tekhn Sb* 9 (1965) 3–7.
- [366] C.J. Wormald, A differential-flow mixing calorimeter, the excess enthalpy of methane + benzene, methane + cyclohexane, and benzene + cyclohexane, *J. Chem. Thermodyn.* 9 (1977) 901–910, doi:10.1016/0021-9614(77)90175-6.
- [367] J.T. Reaves, A.T. Griffith, C.B. Roberts, Critical properties of dilute carbon dioxide + entrainer and ethane + entrainer mixtures, *J. Chem. Eng. Data.* 43 (1998) 683–686, doi:10.1021/je9702753.
- [368] D. Richon, S. Laugier, H. Renon, High-pressure vapor-liquid equilibria for binary mixtures containing a light paraffin and an aromatic compound or a naphthene in the range 313–473 K, *J. Chem. Eng. Data.* 36 (1991) 104–111, doi:10.1021/je00001a032.
- [369] S. Obst, PhD Dissertation, Karl Marx University, Leipzig, 1988.
- [370] M. Klon-Palczewska, Isobaric Vapor-Liquid Equilibrium in Binary Organic Solvent Mixtures, *Chem. Stosow.* 24 (1980) 197–209.
- [371] T. Roscher, *FIZ Rep.* (1970) 12281.
- [372] I. Wichterle, L. Boubliková, Semimicromethod for Determination of Partial Pressures of Solutions, *Ind. Eng. Chem. Fundam.* 8 (1969) 585–588, doi:10.1021/i160031a036.
- [373] P.W. Faux, J.J. Christensen, R.M. Izatt, The excess enthalpies of (n-hexane + toluene) at 308.15, 358.15, 413.15, 470.15, and 573.15 K from 7.50 to 12.50 MPa, *J. Chem. Thermodyn.* 19 (1987) 757–764, doi:10.1016/0021-9614(87)90097-8.
- [374] B. Santos, Microcalorimetry of the heats of mixing. application to binary and ternary systems, *Acta Cient Compostel* 7 (1970) 3–15.
- [375] J.D. Raal, P. Naidoo, Excess enthalpy measurements using a novel highly refined microflow calorimeter and the prediction of vapour-liquid equilibria from such data, *Fluid Phase Equilibria* 57 (1990) 147–160, doi:10.1016/0378-3812(90)80017-6.
- [376] K. Malakondaiah, K. Subbarangaiah, S.V. Subrahmanyam, Excess thermodynamic functions of n-hexane + toluene: application of Flory's theory, *Phys. Chem. Liq.* 23 (1991) 49–56, doi:10.1080/00319109108030632.
- [377] H. Katayama, I. Watanabe, Isobaric vapor-liquid equilibria of the n-heptane-toluene system at subatmospheric pressures, *J. Chem. Eng. Data.* 25 (1980) 107–110, doi:10.1021/je60085a010.
- [378] S. Yerazunis, J.D. Plowright, F.M. Smola, Vapor-liquid equilibrium determination by a new apparatus, *AIChE J* 10 (1964) 660–665, doi:10.1002/aic.690100517.
- [379] F. Garner, R. Hall, *J. Pet. Inst* 41 (1955) 1–18.
- [380] A. Rose, E.T. Williams, Vapor liquid equilibrium self-lagging stills, *Ind. Eng. Chem.* 47 (1955) 1528–1533, doi:10.1021/ie50548a026.
- [381] Howard. Hipkin, H.S. Myers, Vapor-recirculating equilibrium still, *Ind. Eng. Chem.* 46 (1954) 2524–2528, doi:10.1021/ie50540a035.
- [382] H.H. Steinhäuser, R.R. White, Vapor-liquid equilibria data for ternary mixtures: methyl ethyl keton-n-heptane-toluene system, *Ind. Eng. Chem.* 41 (1949) 2912–2920, doi:10.1021/ie50480a062.
- [383] R. Vilcu, Z. Cenuse, Thermodynamic excess functions in liquid-vapor equilibrium n-heptane-toluene system, *Rev. Roum. Chim.* 17 (1972) 367–377.
- [384] Cline. Black, Multicomponent vapor-liquid equilibria from binary data, *Ind. Eng. Chem.* 51 (1959) 211–218, doi:10.1021/ie50590a054.
- [385] V. Mihkelson, H. Kirss, L. Kudrjavzeva, O. Eisen, Vapor-liquid equilibrium T-x measurements by a new semi-micro method, *Fluid Phase Equilibria* 1 (1977) 201–209, doi:10.1016/0378-3812(77)80003-4.
- [386] Y. Liu, R. Xie, Z. Fan, *Huagong Xuebao* 6 (1983) 42–50.
- [387] Y. Chang, The calculation of vapor-liquid equilibrium data for n-heptane-toluene+phenol system, *Ranliao Huaxue Xuebao* 2 (1957) 1–14.
- [388] T. Watanabe, Measurement of vapor-liquid equilibria under low pressure and examination of thermodynamic consistency, *Mem Ariake Coll Tech* (1985) p59–p65.
- [389] E.K. Otsa, V.Y. Mikhkelson, L.S. Kudryavtseva, Heats of mixing in n-alkane - n-alk-1-yne systems, *Russ. J. Phys. Chem.* 53 (1979) 507–509.
- [390] C.C. Tsao, J.M. Smith, Heats of Mixing of Liquids, *Chem Eng Prog Symp Ser* 49 (1953) 107–117.
- [391] K. Tamura, S. Murakami, R. Fujishiro, Excess enthalpies of binary mixtures of aromatic hydrocarbons and aliphatic ketones at 298.15 K, *J. Chem. Thermodyn.* 7 (1975) 1089–1095, doi:10.1016/0021-9614(75)90243-8.
- [392] A.S. Elkabule, D.L. Whitman, R.C. Miller, Excess molar enthalpies of (toluene + n-heptane) and (toluene + methylcyclohexane) using a new variable-volume dilution calorimeter, *J. Chem. Thermodyn.* 20 (1988) 615–620, doi:10.1016/0021-9614(88)90091-2.
- [393] V.T. Bykov, Heats of mixing of liquids, *Zh. Fiz. Khim.* 13 (1939) 1013–1019.
- [394] J.Y. Coxam, S.E. Gillespie, J.L. Oscarson, R.M. Izatt, Excess enthalpies of (toluene+methanol or heptane or methylcyclohexane) and of (heptane+methylcyclohexane) at the temperatures 255.4 K and 310.9 K and the pressure 13.8 MPa, *J. Chem. Thermodyn.* 27 (1995) 1133–1139, doi:10.1006/jcht.1995.0117.
- [395] L. Berg, D. Popovac, Effect of reduced pressure on efficiency of a packed rectification column, *Chem Eng Progr* 45 (1949) 683–691.
- [396] A. Deshpande, B. Lu, *Indian J. Technol.* 1 (1963) 403–404.
- [397] J. Fischer, J. Mackowiak, V. Landau, U. Heinbuch, Dampf-flüssigkeits-phasesgleichgewichte nach der gruppenbeitragstheorie von kehiaian, *Chem Tech Heidelb* 13 (1984) 59–64.
- [398] R.L. Arenosa, C. Menduñia, G. Tardajos, M. Díaz Peña, Excess enthalpies at 298.15 K for binary mixtures of toluene + an n-alkane, *J. Chem. Thermodyn.* 11 (1979) 825–828, doi:10.1016/0021-9614(79)90062-4.
- [399] B. Willman, A.S. Teja, Vapor-liquid equilibria in toluene + m-xylene, toluene + n-decane, and n-decane + m-xylene mixtures, *J. Chem. Eng. Data.* 30 (1985) 116–119, doi:10.1021/je00039a034.
- [400] U. Messow, I. Engel, Thermodynamic studies on solvent-paraffin systems. 7. Toluene (1)-dodecane (2) and toluene (1)-hexadecane (2), *Z Phys Chem Leipz* 258 (1977) 798–800.
- [401] Z. Jin, K. Liu, W. Sheng, Vapor-liquid equilibrium in binary and ternary mixtures of nitrogen, argon, and methane, *J. Chem. Eng. Data.* 38 (1993) 353–355, doi:10.1021/je00011a004.
- [402] H. Kehlen, F. Schneider, S. Haufe, Analysis of dew point measurements of binary systems in the range of medium pressures, *Z Phys Chem Leipz.* 264 (1983) 801–806.
- [403] A.G. Duncan, M.J. Hiza, Heat of mixing derived from liquid-vapor equilibrium data: a study of the argon-methane, normal hydrogen-neon, and normal deuterium-neon systems, *Ind. Eng. Chem. Fundam.* 11 (1972) 38–45, doi:10.1021/i160041a007.
- [404] K.L. Lewis, L.A.K. Staveley, Excess enthalpies of the liquid mixtures nitrogen + oxygen, nitrogen + argon, argon + ethane, and methane + carbon tetrafluoride, *J. Chem. Thermodyn.* 7 (1975) 855–864, doi:10.1016/0021-9614(75)90094-4.
- [405] E.J.S.G. Azevedo, J.A. Zollweg, J.C.G. Calado, Thermodynamics of liquid mix-

- tures: (argon+ethane), *J. Chem. Thermodyn.* 26 (1994) 847–856, doi:10.1006/jcht.1994.1101.
- [406] E. Sarashina, Y. Arai, S. Sasto, The P-V-T-X relation for the carbon dioxide-argon system, *J. Chem. Eng. Jpn.* 4 (1971) 379–381, doi:10.1252/jcej.4.379.
- [407] C. Coquelet, A. Valtz, F. Dieu, D. Richon, P. Arpentiner, F. Lockwood, Isothermal P, x, y data for the argon+carbon dioxide system at six temperatures from 233.32 to 299.21K and pressures up to 14MPa, *Fluid Phase Equilibria* 273 (2008) 38–43, doi:10.1016/j.fluid.2008.08.010.
- [408] K.L. Lewis, S.E. Mosedale, C.J. Wormald, The enthalpy of mixing of argon + nitrogen at 123, 130, and 140 K at pressures up to 10.1 MPa, *J. Chem. Thermodyn.* 9 (1977) 221–229, doi:10.1016/0021-9614(77)90041-6.
- [409] P.L. Thorpe, Liquid-vapour equilibrium of the system nitrogen+argon at pressures up to 10 atm, *Trans. Faraday Soc.* 64 (1968) 2273–2280, doi:10.1039/TF9686402273.
- [410] D.R. Massengill, R.C. Miller, Temperature dependence of excess volumes for simple liquid mixtures: N<sub>2</sub>+Ar, N<sub>2</sub>+Ar+CH<sub>4</sub>, *J. Chem. Thermodyn.* 5 (1973) 207–217, doi:10.1016/S0021-9614(73)80080-1.
- [411] V. Fastovskii, Y. Petrovskii, V. Lenin, Investigation of the argon–nitrogen liquid– and vapor–phase equilibrium. I, *Zhurnal Fiz. Khim.* 30 (1956) 76–78.
- [412] G. Wilson, P. Silverberg, M. Zellner, Argon–oxygen–nitrogen three–component system: experimental vapor–liquid equilibrium data, *Adv. Cryog. Eng.* 10 (1964) 192–208.
- [413] G. Narinskii, Study of liquid–vapor equilibrium in the argon–nitrogen system. I. Experimental data and their verification, *Russ. J. Phys. Chem.* 40 (1966) 1093–1096.
- [414] S. Mastera, Vapor–Liquid Equilibrium Data of the Systems Ar–N<sub>2</sub>, Kr–Ar, Kr–N<sub>2</sub> and Xe–Kr and Limits of Solubility of Solid Xenon and Solid Krypton in Liquid Components of Air (Thesis) (1976).
- [415] A. Baba-Ahmed, P. Guilbot, D. Richon, New equipment using a static analytical method for the study of vapour–liquid equilibria at temperatures down to 77 K, *Fluid Phase Equilibria.* 166 (1999) 225–236, doi:10.1016/S0378-3812(99)00294-0.
- [416] F. Dolezalek, *Z. Phys. Chem. Stoechiom. Verwandtschaftsftl.* (1993) 353–355.
- [417] N. Orobinskii, Y. Blagoi, O. Semyannikova, Liquid–vapor phase equilibrium of the propylene–argon and propylene–krypton systems at high temperatures, *Ukr. Phys. J.* 13 (1968) 263–268.
- [418] Y. Blagoi, M. Orobinskii, Vapor–liquid equilibrium of the system propylene – argon, *Ukr. Fiz. Zhurnal.* 8 (1963) 1378–1385.
- [419] J.C.G. Calado, W.B. Streett, Liquid–vapor equilibrium in the system H<sub>2</sub> Ar at temperatures from 83 to 141 K and pressures to 52 MPa, *Fluid Phase Equilibria.* 2 (1979) 275–282, doi:10.1016/0378-3812(79)80012-6.
- [420] M. Ostronov, L. Shatskaya, R. Finyagina, Gas–liquid phase equilibrium in the argon–hydrogen system at intermediate pressures, *Russ. J. Phys. Chem.* 51 (1977) 1407–1409.
- [421] D. Houssin-Agbonmson, C. Coquelet, P. Arpentiner, F. Delcorso, D. Richon, Equilibrium data for the oxygen + propane binary system at temperatures of (110.22, 120.13, 130.58, and 139.95) K, *J. Chem. Eng. Data.* 55 (2010) 4412–4415, doi:10.1021/jc100574y.
- [422] K. Fischer, M. Wilken, Experimental determination of oxygen and nitrogen solubility in organic solvents up to 10 MPa at temperatures between 298 K and 398 K, *J. Chem. Thermodyn.* 33 (2001) 1285–1308, doi:10.1006/jcht.2001.0837.
- [423] K. Fischer, O. Noll, J. Gmehling, Experimental Determination of the Oxygen Solubility in Benzene, *J. Chem. Eng. Data.* 46 (2001) 1504–1505, doi:10.1021/jc101063i.
- [424] A. Li, S. Tang, P. Tan, C. Liu, B. Liang, Measurement and prediction of oxygen solubility in toluene at temperatures from 298.45 K to 393.15 K and pressures up to 1.0 MPa, *J. Chem. Eng. Data.* 52 (2007) 2339–2344, doi:10.1021/jc100330c.
- [425] P.L. Chueh, N.K. Muirbrook, J.M. Prausnitz, Multicomponent vapor–liquid equilibria at high pressures: part II. thermodynamic analysis, *AIChE J.* 11 (1965) 1097–1102, doi:10.1002/aic.690110625.
- [426] H.S. Booth, J.M. Carter, The critical constants of carbon dioxide–oxygen mixtures, *J. Phys. Chem.* 34 (1930) 2801–2825, doi:10.1021/j150318a013.
- [427] M. Ahmad, J. Gernert, E. Wilbers, Effect of impurities in captured CO<sub>2</sub> on liquid–vapor equilibrium, *Fluid Phase Equilibria.* 363 (2014) 149–155, doi:10.1016/j.fluid.2013.11.009.
- [428] A. Fredenslund, G.A. Sather, Gas–liquid equilibrium of the oxygen–carbon dioxide system, *J. Chem. Eng. Data.* 15 (1970) 17–22, doi:10.1021/jc60044a024.
- [429] A. Fredenslund, J. Mollerup, O. Persson, Gas–liquid equilibrium of oxygen–carbon dioxide system, *J. Chem. Eng. Data.* 17 (1972) 440–443, doi:10.1021/jc60055a019.
- [430] S.F. Westman, H.G.J. Stang, S.W. Løvseth, A. Austegard, I. Snustad, I.S. Ertesvåg, Vapor–liquid equilibrium data for the carbon dioxide and oxygen (CO<sub>2</sub>+O<sub>2</sub>) system at the temperatures 218, 233, 253, 273, 288 and 298 K and pressures up to 14 MPa, *Fluid Phase Equilibria.* 421 (2016) 67–87, doi:10.1016/j.fluid.2016.04.002.
- [431] S. Lasala, P. Chiesa, R. Privat, J.-N. Jaubert, VLE properties of CO<sub>2</sub> – Based binary systems containing N<sub>2</sub>, O<sub>2</sub> and Ar: Experimental measurements and modelling results with advanced cubic equations of state, *Fluid Phase Equilibria.* 428 (2016) 18–31, doi:10.1016/j.fluid.2016.05.015.
- [432] M. Yorizane, S. Yoshimura, H. Masuoka, A. Toyama, Y. Nakako, I. Funada, Measurement and estimation of low temperature vapor–liquid equilibrium for the system oxygen–argon at high oxygen concentrations, *Chem. Eng. Sci.* 33 (1978) 641–649, doi:10.1016/0009-2509(78)80040-2.
- [433] F. Din, The liquid–vapor equilibrium of the system nitrogen+oxygen at pressures up to 10 atm, *Trans. Faraday Soc.* 56 (1960) 668–681, doi:10.1039/TF9605600668.
- [434] R. Thorogood, G. Haselden, Determination of equilibrium data for the O–N system at high O concentrations, *Br. Chem. Eng.* 8 (1963) 623–625.
- [435] A.H. Cockett, D.M. Newitt, The binary system nitrogen–oxygen at 1–3158 atm, in: *Proc. R. Soc. Lond. Ser. Math. Phys. Sci.*, 239, 1957, pp. 76–92, doi:10.1098/rspa.1957.0023.
- [436] B.F. Dodge, A.K. Dunbar, An investigation of the coexisting liquid and vapor phases of solutions of oxygen and nitrogen, *J. Am. Chem. Soc.* 49 (1927) 591–610, doi:10.1021/ja01402a002.
- [437] G.T. Armstrong, J.M. Goldstein, D.E. Roberts, Liquid–vapor phase equilibrium in solutions of oxygen and nitrogen at pressures below one atmosphere, *J. Res. Natl. Bur. Stand.* 55 (1955) 265, doi:10.6028/jres.055.031.
- [438] B.E. DODGE, *Isotherms and Isobars for Air Separation Studies*, *Chem. Met. Eng.* 35 (1928) 622.
- [439] I. Krichevskii, N. Torocheshnikov, Thermodynamics of the vapor – liquid equilibrium in the system nitrogen – oxygen, *Zh. Fiz. Khim.* 8 (1936) 273–280.
- [440] J.K.H. Inglis, LVIII. The isothermal distillation of nitrogen and oxygen and of argon and oxygen, *Lond. Edinb. Dublin Philos. Mag. J. Sci.* 11 (1906) 640–658, doi:10.1080/14786440609463483.
- [441] V.G. Baidakov, A.M. Kaverin, V.N. Andbaeva, The liquid–gas interface of oxygen–nitrogen solutions: 1. surface tension, *Fluid Phase Equilibria.* 270 (2008) 116–120, doi:10.1016/j.fluid.2008.06.016.
- [442] C.M. Knobler, R.J.J. Van Heijningen, J.J.M. Beenakker, Excess thermodynamic properties of the liquid systems O<sub>2</sub>-A and O<sub>2</sub>-N<sub>2</sub>, *Physica.* 27 (1961) 296–308, doi:10.1016/0031-8914(61)90102-1.
- [443] M.L. Japas, E.U. Franck, High pressure phase equilibria and PVT-data of the water–oxygen system including water–air to 673 K and 250 MPa, *Berichte Bunsenges. Für Phys. Chem.* 89 (1985) 1268–1275, doi:10.1002/bbpc.19850891206.
- [444] E.F. Stephan, N.S. Hatfield, R.S. Peoples, H. a. H. Pray, the solubility of gases in water and in aqueous uranyl salt solutions at elevated temperatures and pressures, Battelle Memorial Inst., Columbus, Ohio (1956) <https://www.osti.gov/biblio/4379406>. (accessed October 10, 2019).
- [445] A.M. Clark, F. Din, J. Robb, The liquid–vapor equilibrium of the binary system argon/oxygen, *Proc. R. Soc. Lond. Ser. A.* 221 (1954) 517–534.
- [446] P. Bourbo, I. Ischkin, Study of the vapor – liquid equilibrium of the system argon – oxygen, *Phys. Z. Sowjetunion.* 10 (1936) 271–291.
- [447] A. Baba-Ahmed, Etude d'équilibres liquide–vapeur dans le domaine cryogénique conception et développement d'un appareillage mesure et modélisation, Ecole des Mines de Paris, Paris (1999) 97.
- [448] I. Burn, F. Din, Liquid–vapor equilibrium of the system argon+oxygen at pressures up to 10 atmospheres, *Trans. Faraday Soc.* 58 (1962) 1341–1356, doi:10.1039/TF9625801341.
- [449] V. Fastovskii, Y. Petrovskii, The liquid–vapor equilibrium in the argon–oxygen system, *Zh. Fiz. Khim.* 29 (1955) 1311–1317.
- [450] G.B. Narinskii, Experimental data on Liquid–Vapor Equilibrium in the Oxygen–Argon System at 90.5 Degrees, 100 Degrees, 110 Degrees and 120 Degrees K, *Kislorod.* 3 (1957) 9–16.
- [451] E. El Ahmar, B. Creton, A. Valtz, C. Coquelet, V. Lachet, D. Richon, P. Ungerer, Thermodynamic study of binary systems containing sulphur dioxide: measurements and molecular modelling, *Fluid Phase Equilibria.* 304 (2011) 21–34, doi:10.1016/j.fluid.2011.02.008.
- [452] F. Zhang, E. El Ahmar, A. Valtz, E. Boonaert, C. Coquelet, A. Chapoy, Phase equilibrium of three binary mixtures containing NO and components present in ambient air, *J. Chem. Eng. Data.* 63 (2018) 1021–1026, doi:10.1021/acs.jced.7b00782.
- [453] D. Tsiklis, G. Svetlova, The solubility of gases in cyclohexane, *Zh. Fiz. Khim.* 32 (1958) 1476–1480.
- [454] U. Scheunemann, H. Wagner, An apparatus for the determination of low-temperature liquid–vapor equilibria and measurements in the nitrogen–nitrogen oxide (N<sub>2</sub>-NO) system, *Ber. Bunsen-Ges. Phys. Chem.* 89 (1985) 1285–1292.
- [455] X. Xu, R. Privat, J.-N. Jaubert, V. Lachet, B. Creton, Phase equilibrium of CCS mixtures: equation of state modeling and Monte Carlo simulation, *J. Super-crit. Fluids.* 119 (2017) 169–202, doi:10.1016/j.supflu.2016.09.013.
- [456] ARMINES, Private Commun. (2022).
- [457] S. Glowka, liquid–vapor equilibria and thermodynamic functions of propane – sulfur dioxide and propane – dimethyl ether systems up to 300 C, *Bull. Acad. Polym. Sci. Ser. Sci. Chim.* 20 (1972) 163–167.
- [458] M.P. Matuszak, F.E. Frey, Separating butenes from butanes, *Ind. Eng. Chem. Anal. Ed.* 9 (1937) 111–115, doi:10.1021/ac50107a003.
- [459] M.R. Dean, W.S. Walls, Solubility of Nitrogen and Methane in Sulfur Dioxide, *Ind. Eng. Chem.* 39 (1947) 1049–1051, doi:10.1021/jc50452a027.
- [460] J. Lorimer, B. Smith, G. Smith, Total vapor pressures, thermodynamic excess functions, and complex formation in binary liquid mixtures of organic solvents and sulfur dioxide, *J. Chem. Soc. Faraday Trans. 71* (1975) 2232–2250.
- [461] C. Coquelet, A. Valtz, P. Arpentiner, Thermodynamic study of binary and ternary systems containing CO<sub>2</sub>+impurities in the context of CO<sub>2</sub> transportation, *Fluid Phase Equilibria* 382 (2014) 205–211, doi:10.1016/j.fluid.2014.08.031.
- [462] V. Lachet, T. de Bruin, P. Ungerer, C. Coquelet, A. Valtz, V. Hasanov, F. Lockwood, D. Richon, Thermodynamic behavior of the CO<sub>2</sub>+SO<sub>2</sub> mixture: experimental and Monte Carlo simulation studies, *Energy Procedia* 1 (2009) 1641–1647, doi:10.1016/j.egypro.2009.01.215.

- [463] B. Rumpf, G. Maurer, Solubilities of hydrogen cyanide and sulfur dioxide in water at temperatures from 293.15 to 413.15 K and pressures up to 2.5 MPa, *Fluid Phase Equilibria* 81 (1992) 241–260, doi:10.1016/0378-3812(92)85155-2.
- [464] P.B. Ayscough, K.J. Ivin, J.H. O'Donnell, Vapour pressure of the system isobutene + sulphur dioxide, *Trans. Faraday Soc.* 61 (1965) 1601–1607, doi:10.1039/TF9656101601.
- [465] B.H.G. Brady, J.H. O'Donnell, Activity coefficients in binary liquid mixtures of 3-methyl butene-1 and sulphur dioxide, *Trans. Faraday Soc.* 64 (1968) 23–28, doi:10.1039/TF9686400023.
- [466] E. El Ahmar, A. Valtz, C. Coquelet, VLE study of sulfur dioxide containing binary mixtures, in: *24th European Symposium on Applied Thermodynamics; Arce, A., Soto, A., Eds., 2009 (n.d.)*.
- [467] N.H. Senturk, H. Kalra, D.B. Robinson, Vapor-liquid equilibrium in the methane-carbonyl sulfide binary system, *J. Chem. Eng. Data.* 24 (1979) 311–313, doi:10.1021/je60083a010.
- [468] R.J. McDougal, L.V. Jasperson, G.M. Wilson, Vapor-liquid equilibrium for several compounds relevant to the biofuels industry modeled with the Wilson Equation, *J. Chem. Eng. Data.* 59 (2014) 1069–1085, doi:10.1021/je400885z.
- [469] P. Guilbot, P. Théveneau, A. Baba-Ahmed, S. Horstmann, K. Fischer, D. Richon, Vapor-liquid equilibrium data and critical points for the system H<sub>2</sub>S-COS. Extension of the PSRK group contribution equation of state, *Fluid Phase Equilibria* 170 (2000) 193–202, doi:10.1016/S0378-3812(00)00352-6.
- [470] H. Zeininger, Flüssigkeits/Dampf-Gleichgewichte der binären Systeme N<sub>2</sub>O/N<sub>2</sub>, N<sub>2</sub>O/O<sub>2</sub> und N<sub>2</sub>O/CH<sub>4</sub> bei tiefen Temperaturen und hohen Drücken, *Chem. Ing. Tech.* 44 (1972) 607–612, doi:10.1002/cite.330440903.
- [471] S. Horstmann, K. Fischer, J. Gmehling, Experimental determination of critical data of mixtures and their relevance for the development of thermodynamic models, *Chem. Eng. Sci.* 56 (2001) 6905–6913, doi:10.1016/S0009-2509(01)00332-3.
- [472] D. Cook, J.E. Lennard-Jones, The carbon-dioxide-nitrous-oxide system in the critical region, *Proc. R. Soc. Lond. Ser. Math. Phys. Sci.* 219 (1953) 245–256, doi:10.1098/rspa.1953.0143.
- [473] C.J. Wormald, J.M. Eyears, Excess enthalpies and excess volumes of [xCO<sub>2</sub>+(1-x)N<sub>2</sub>O] in the liquid and supercritical regions, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases.* 84 (1988) 3097–3106, doi:10.1039/F19888403097.
- [474] A. Cabañas, J.A.R. Renuncio, C. Pando, Thermodynamic Study of the N<sub>2</sub>O + CO<sub>2</sub> and N<sub>2</sub>O + CO<sub>2</sub> + Cyclohexane Systems in the Near-Critical and Supercritical Regions, *Ind. Eng. Chem. Res.* 39 (2000) 3566–3575, doi:10.1021/ie0000919.
- [475] N.E. Kosyakov, N.P. Yakimenko, L.L. Chobotko, Production of medicinal nitrous oxide, *Zh. Prikl. Khim.* 57 (1984) 2591.
- [476] F.-Y. Jou, J.J. Carroll, A.E. Mather, F.D. Otto, The Solubility of Nitrous Oxide in Water at High Temperatures and Pressures, *Z. Für Phys. Chem.* 177 (1992) 225–239, doi:10.1524/zpch.1992.177.Part\_2.225.
- [477] A.B. Brackeen, G.B. Broughton, D.W. Hill, Equilibria for mixtures of oxygen with nitrous oxide and carbon dioxide and their relevance to the storage of N<sub>2</sub>O/O<sub>2</sub> cylinders for use in analgesia, *J. Phys. Appl. Phys.* 3 (1970) 1747–1758, doi:10.1088/0022-3727/3/11/325.
- [478] S. Camy, J.-J. Letourneau, J.-S. Condoret, Experimental study of high pressure phase equilibrium of (CO<sub>2</sub>+NO<sub>2</sub>/N<sub>2</sub>O<sub>4</sub>) mixtures, *J. Chem. Thermodyn.* 43 (2011) 1954–1960, doi:10.1016/j.jct.2011.07.007.
- [479] E.T. Chang, N.A. Gokcen, Thermodynamic Properties of Gases in Propellants and Oxidizers. I. Solubilities of He, N<sub>2</sub>, O<sub>2</sub>, Ar, and N<sub>2</sub>O<sub>4</sub> in Liquid N<sub>2</sub>O<sub>4</sub>, *J. Phys. Chem.* 70 (1966) 2394–2399, doi:10.1021/j100879a050.
- [480] H. Lentz, M. Weber, P. V. T, x values of the gas-liquid phase equilibria in the binary system methane-ammonia at high pressures, *Fluid Phase Equilibria* 93 (1994) 363–368, doi:10.1016/0378-3812(94)87019-5.
- [481] E. Naumowicz-Węglińska, W. Wóycicki, Excess enthalpies of gaseous mixtures containing ammonia 2. (Ammonia + nitrogen) and (ammonia + methane), *J. Chem. Thermodyn.* 18 (1986) 1047–1052, doi:10.1016/0021-9614(86)90019-4.
- [482] M.M. Elborai, PhD thesis, University of Karlsruhe, 1974.
- [483] I.R. Krichevskii, G.D. Efremova, *Zh. Fiz. Khim.* 27 (1953) 1682–1685.
- [484] S. Głównka, Volumetric properties of ammonia + argon, + helium, + methane, and + nitrogen mixtures between 298 and 423 K by the Burnett-isochoric method, *Fluid Phase Equilibria* 78 (1992) 285–296, doi:10.1016/0378-3812(92)87042-L.
- [485] L.R. Lishnits, N.G. Tyurikova, I.B. Rodkina, Solubility of liquid ammonia in methane and in argon, *Khim. Promst. Mosc.* 7 (1988) 406–408.
- [486] R. Wiebe, T.H. Tremearne, Solubility of Nitrogen in Liquid Ammonia at 25° from 25 to 1000 Atmospheres, *J. Am. Chem. Soc.* 55 (1933) 975–978, doi:10.1021/ja01330a016.
- [487] R. Wiebe, V.L. Gaddy, The Solubility in Liquid Ammonia of Hydrogen at 0° and of Nitrogen at 0, 50, 75, 90 and 100° at Pressures to 1000 Atmospheres. Critical Phenomena of Ammonia-Nitrogen Mixtures I, *J. Am. Chem. Soc.* 59 (1937) 1984–1987, doi:10.1021/ja01289a055.
- [488] H.H. Reamer, B.H. Sage, Phase behavior in the nitrogen-ammonia system, *J. Chem. Eng. Data.* 4 (1959) 303–305, doi:10.1021/je60004a005.
- [489] A.E. Lindroos, B.F. Dodge, Phase-equilibria at high pressures; the system nitrogen- ammonia at pressures above 1000 atmospheres, *Chem. Eng. Progr. Symp. Ser.* 48 (1952) 10–17.
- [490] F. Heise, Flüssigkeits-Dampfgleichgewichte zwischen Ammoniak und verschiedenen Gasen, *Berichte Bunsenges. Für Phys. Chem.* 76 (1972) 938–943, doi:10.1002/bbpc.19720760914.
- [491] G. Kaminishi, T. Toriumi, The concentration of ammonia vapor in compressed nitrogen and hydrogen over liquid ammonia, *Tohoku Daigaku Hisui Yoeki Kagaku Kenkyusho Hokoku* 11 (1962) 1–12.
- [492] I.R. Krichevskii, N.E. Khazanova, Content of ammonia in compressed hydrogen and nitrogen in equilibrium with liquid ammonia, *Zh. Fiz. Khim.* 13 (1939) 1690–1693.
- [493] C.L. Sassen, R.A.C. Van Kwartel, H.J. Van der Kooij, J. De Swaan Arons, Vapor-liquid equilibria for the system ammonia + water up to the critical region, *J. Chem. Eng. Data.* 35 (1990) 140–144, doi:10.1021/je00060a013.
- [494] N.G. Polikhronidi, I.M. Abdulagatov, R.G. Batyrova, G.V. Stepanov, PVT measurements of water-ammonia refrigerant mixture in the critical and supercritical regions, *Int. J. Refrig.* 32 (2009) 1897–1913, doi:10.1016/j.jrefrig.2009.07.008.
- [495] A. Sakabe, D. Arai, H. Miyamoto, M. Uematsu, Measurements of the critical parameters for {xNH<sub>3</sub>+(1-x)H<sub>2</sub>O} with x=(0.9098,0.7757,0.6808), *J. Chem. Thermodyn.* 40 (2008) 1527–1530, doi:10.1016/j.jct.2008.05.017.
- [496] H. Inomata, N. Ikawa, K. Arai, S. Saito, Vapor-liquid equilibria for the ammonia-methanol-water system, *J. Chem. Eng. Data.* 33 (1988) 26–29, doi:10.1021/je00051a010.
- [497] G. Müller, E. Bender, G. Maurer, Das Dampf-Flüssigkeitsgleichgewicht des ternären Systems Ammoniak-kohlendioxid-wasser bei hohen Wassergehalten im Bereich zwischen 373 und 473 Kelvin, *Ber. Bunsenges. Phys. Chem.* 92 (1988) 148–160.
- [498] I.I. Clifford, E. Hunter, The System Ammonia-Water at Temperatures up to 150°C. and at Pressures up to Twenty Atmospheres, *J. Phys. Chem.* 37 (1933) 101–118, doi:10.1021/j150343a014.
- [499] T.M. Smolen, D.B. Manley, B.E. Poling, Vapor-liquid equilibrium data for the ammonia-water system and its description with a modified cubic equation of state, *J. Chem. Eng. Data.* 36 (1991) 202–208, doi:10.1021/je00002a017.
- [500] S.S.H. Rizvi, R.A. Heidemann, Vapor-liquid equilibria in the ammonia-water system, *J. Chem. Eng. Data.* 32 (1987) 183–191, doi:10.1021/je00048a017.
- [501] J.L. Guillevic, D. Richon, H. Renon, Vapor-liquid equilibrium data for the binary system water-ammonia at 403.1, 453.1, and 503.1 K up to 7.0 MPa, *J. Chem. Eng. Data.* 30 (1985) 332–335, doi:10.1021/je00041a030.
- [502] E.M. Pawlikowski, J. Newman, J.M. Prausnitz, Phase equilibria for aqueous solutions of ammonia and carbon dioxide, *Ind. Eng. Chem. Process Des. Dev.* 21 (1982) 764–770, doi:10.1021/i200019a036.
- [503] J.F. Shultz, G.V. Elmore, The system ammonium nitrate-ammonia-water, *Ind. Eng. Chem.* 38 (1946) 296–298, doi:10.1021/ie50435a017.
- [504] L.-J. Huang, W.-L. Xue, Z.-X. Zeng, The Solubility of ammonia in ethanol between 277.35K and 328.15K, *Fluid Phase Equilibria* 303 (2011) 80–84, doi:10.1016/j.fluid.2011.01.006.
- [505] D. Salavera, S.K. Chaudhari, X. Esteve, A. Coronas, Vapor-liquid equilibria of ammonia + water + potassium hydroxide and ammonia + water + sodium hydroxide solutions at temperatures from (293.15 to 353.15) K, *J. Chem. Eng. Data.* 50 (2005) 471–476, doi:10.1021/je049708+.
- [506] C.S. Huey, H.V. Tartar, The partial vapor pressures of water and ammonia from the system water- phosphoric acid-ammonia, *J. Am. Chem. Soc.* 62 (1940) 26–32, doi:10.1021/ja01858a006.
- [507] P.C. Gillespie, W.V. Wilding, G.M. Wilson, Vapor- liquid equilibrium measurements on the ammonia- water system from 313 K to 589 K, *AIChE Symp. Ser.* 83 (1987) 97–127.
- [508] W. Huang, G. Sun, D. Zheng, L. Dong, X. Wu, J. Chen, Vapor-liquid equilibrium measurements of NH<sub>3</sub> + H<sub>2</sub>O + Ionic Liquid ([Dmim]Cl, [Dmim]BF<sub>4</sub>, and [Dmim]DMP) Systems, *J. Chem. Eng. Data.* 58 (2013) 1354–1360, doi:10.1021/je400109a.
- [509] D. Hoshino, K. Nagahama, M. Hirata, A new apparatus for measuring vapor-liquid equilibria of gas-solvent systems at constant pressure, *Bull. Jpn. Pet. Inst.* 17 (1975) 9–13, doi:10.1627/jpi.1959.17.9.
- [510] C.D. Holcomb, S.L. Outcalt, Near-saturation (P,ρ,T) and vapor-pressure measurements of NH<sub>3</sub>, and liquid-phase isothermal (P,ρ,T) and bubble-point-pressure measurements of NH<sub>3</sub>+H<sub>2</sub>O mixtures, *Fluid Phase Equilibria* 164 (1999) 97–106, doi:10.1016/S0378-3812(99)00242-3.
- [511] T. Munakata, K. Kasahara, M. Uematsu, ( p, ρ, T) measurements of (ammonia+ water) in the temperature range 310 K to 400 K at pressures up to 17 MPa. I. Measurements of { xNH<sub>3</sub> + (1 - x) H<sub>2</sub>O } at x= (0.8952, 0.8041, 0.6985, 0.5052, and 0.1016), *J. Chem. Thermodyn.* 34 (2002) 807–819, doi:10.1006/jct.2001.0930.
- [512] J. Polak, B.C.Y. Lu, Vapor-liquid equilibria in system ammonia-water at 14.69 and 65 psia, *J. Chem. Eng. Data.* 20 (1975) 182–183, doi:10.1021/je60065a005.
- [513] T. Sako, T. Hakuta, H. Yoshitome, Vapor-liquid equilibria for single weak electrolyte aqueous solutions in dilute regions, *J. Chem. Eng. Jpn.* 18 (1985) 420–426, doi:10.1252/jcej.18.420.
- [514] J. Chu, R. Getty, L. Brennecke, *Distillation Equilibrium Data*, Reinhold Pub. Corp. (1950).
- [515] J.C. Mani, B. Cuony, 6th RXE User Forum Eur., Zermatt, Suisse (1993) 3–17.
- [516] P. Verbrugghe, Ph.D. thesis, Delft University of Technology, 1979.
- [517] F. Harms-Watzenberg, H.D. Baehr, F. Harms-Watzenberg, H.D. Baehr, *DKV-Tagungsberichte* (1994) 1994.
- [518] X. Xu, L. An, G. Zheng, G. Bai, Measurement of vapor-liquid equilibrium data for products in methanol amination, *Gaoxiao Huaxue Gongcheng Xuebao* 9 (1995) 97–105.
- [519] M. Iseli, Ph.D. thesis, ETH, 1985.
- [520] F. Harms-Watzenberg, VDI Forschungsh Reihe 3 Verfahrenst 380 (1995) 1–125.

- [521] B.H. Jennings, ASHRAE Trans. 71 (1965) 21–29.
- [522] S. Han, G. Chen, R. Lin, D. Liu, Huaxue Gongcheng 9 (1981) 12–20.
- [523] J. Isoire, R. Pfortzel, Thermophysical properties, Chim Ind Genie Chim. 86 (1961) 101–109.
- [524] H.J. Staudt, Ph.D. thesis (1984).
- [525] H.H. Reamer, B.H. Sage, Phase behavior in the hydrogen-ammonia system, J. Chem. Eng. Data. 4 (1959) 152–154, doi:10.1021/je60002a012.
- [526] R. Wiebe, T.H. Tremearne, The solubility of hydrogen in liquid ammonia at 25, 50, 75 and 100° and at pressures to 1000 atmospheres, J. Am. Chem. Soc. 56 (1934) 2357–2360, doi:10.1021/ja01326a039.
- [527] A. Michels, E. Dumoulin, J.J.Th. Van Dijk, Gas-liquid phase equilibrium in the system NH<sub>3</sub>-A, Physica 27 (1961) 886–892, doi:10.1016/0031-8914(61)90088-X.
- [528] E. Naumowicz, W. Wóycicki, Excess enthalpies of gaseous mixtures containing ammonia 1. (Ammonia + argon), J. Chem. Thermodyn. 16 (1984) 1081–1088, doi:10.1016/0021-9614(84)90137-X.
- [529] J. Matouš, J. Šobr, J.P. Novák, Solubility of argon, and gaseous mixture argon-methane-nitrogen in liquid ammonia, Collect. Czechoslov. Chem. Commun. 35 (1970) 3757–3761, doi:10.1135/cccc19703757.
- [530] W.S. Walls, M.R. Dean, Separation of methylacetylene from C<sub>4</sub> hydrocarbons, US2371860A, 1945. <https://patents.google.com/patent/US2371860A/en> (accessed October 13, 2019).
- [531] E.A. Kyser, Experimental vapor-liquid equilibria of propyne with propane, propene and propadiene (1987) <http://www.proquest.com/openview/608a062a1a1df4e94e642a07dec29233/1?cbl=18750&diss=y&pq-origsite=gscholar>. (accessed August 9, 2021).
- [532] T. Tsuji, T. Sato, T. Kondo, R. Uematsu, T. Hiaki, M. Namba, Bubble point pressure for five binaries concerning liquefied petroleum gas, propane + 1-pentyne, propane + 1-hexyne, propane + 2-hexyne, propane + cyclopentene, propane + 1,5-cyclooctadiene, in: 18th Eur. Conf. Thermophys. Prop., 2008.
- [533] W. Wóycicki, P. Rhenius, Excess enthalpies of binary mixtures containing unsaturated hydrocarbons 3. n-Alkane + n-alkyne and tetrachloromethane + n-alkyne, J. Chem. Thermodyn. 11 (1979) 153–158, doi:10.1016/0021-9614(79)90164-2.
- [534] E. Wilhelm, A. Inglese, J.-P.E. Grolier, H.V. Kehiaian, Thermodynamics of binary mixtures containing allkynes, Monatshefte Für Chem. Chem. Mon. 109 (1978) 235–243, doi:10.1007/BF00911966.
- [535] G. Belaribi, A. Ait-Kaci, J. Jose, Liquid-vapor equilibrium and excess Gibbs energy of 1-hexyne + decane, Int DATA Ser Sel Data Mix. Ser A. 19 (1991) 74–76.
- [536] G. Boukais-Belaribi, B.F. Belaribi, A. Ait-Kaci, J. Jose, Thermodynamics of n-octane+hexynes binary mixtures, Fluid Phase Equilibria 167 (2000) 83–97, doi:10.1016/S0378-3812(99)00306-4.
- [537] A. Ait-Kaci, J. Jose, G. Belaribi, Int. Data Ser. Sel. Data Mix. Ser. A. 2 (1989) 105–107.
- [538] E. Otsa, L.S. Kudrjawzewa, O.G. Eisen, Thermodynamische Untersuchungen ann-Alkan/n-Alkin-Systemen, Monatshefte Für Chem. Chem. Mon. 111 (1980) 37–42, doi:10.1007/BF00938715.
- [539] L.S. Kudryavtseva, E. Otsa, H. Kirss, Termodin. Organ Soedin (1981) 79–81.
- [540] V. Fried, J. Vitovec, Gleichgewicht flüssigkeit-dampf XXIII. Phasengleichgewichte in den zweistoffsystemen vinylacetylen-benzol, vinylacetylen-toluol und vinylacetylen-p-xytol, Collect. Czechoslov. Chem. Commun. 25 (1960) 1642–1648, doi:10.1135/cccc19601642.
- [541] J. Vitovec, V. Fried, Löslichkeit des vinylacetylen in benzol, toluol und p-xytol, Collect. Czechoslov. Chem. Commun. 25 (1960) 2218–2221, doi:10.1135/cccc19602218.
- [542] T.M. Letcher, F.E.Z. Schoonbaert, J. Mercer-Chalmers, The excess enthalpy and excess volume of (benzene+oct-1-yne) at 298.15 K, J. Chem. Thermodyn. 22 (1990) 815–816, doi:10.1016/0021-9614(90)90073-Y.
- [543] T.M. Letcher, A. Koteswari Prasad, The excess enthalpy and excess volume of (1,3,5-trimethylbenzene + an alk-1-yne) at the temperature 298.15 K, J. Chem. Thermodyn. 23 (1991) 643–646, doi:10.1016/S0021-9614(05)80201-0.
- [544] H. Kirss, E. Siimer, L. Kudryavtseva, Isobaric vapor-liquid equilibria in the mixtures of 1- heptyne + butanal, 1-octyne + 3-octyne, +ethylbenzene and +dibutyl ether, 2-octyne + dibutyl ether and + 1-butanol, and 3-octyne + 1-octene, Thermochim. Acta. 228 (1993) 283–289, doi:10.1016/0040-6031(93)80297-N.
- [545] T.M. Letcher, S. Taylor, R. Baxter, Excess molar enthalpies of (a cycloalkane + an alk-1-yne) at 298.15 K, J. Chem. Thermodyn. 20 (1988) 1265–1269, doi:10.1016/0021-9614(88)90162-0.
- [546] K.E. Doering, H. Preuss, Vapor pressures of mixtures propane- propyne (1967).
- [547] H. Preuss, T. Roscher, 1980.
- [548] P. Griпка, Master thesis, University of Missouri-Rolla, 1988.
- [549] H. Kirss, M. Kuus, E. Siimer, L. Kudryavtseva, Measurement, correlation and prediction of binary vapour-liquid equilibria and enthalpies of mixing for systems containing isomeric alkynes, Thermochim. Acta. 195 (1992) 85–94, doi:10.1016/0040-6031(92)80051-W.
- [550] K.E. Doering, H. Preuss, 1967.
- [551] R.J. Burch, M.W. Leeds, Vapor-Liquid Equilibria in the Acetylene-Propyne System, Ind. Eng. Chem. Chem. Eng. Data Ser. 2 (1957) 3–7, doi:10.1021/i460002a001.
- [552] M. Bardas, N. Dahmen, T. Kraska, K.-D. Wagner, L. Yelash, Isothermal vapor-liquid equilibria of binary systems of carbon dioxide and 1-butyne, compared to other binary CO<sub>2</sub> + C<sub>4</sub>Hn systems in terms of global parameters, Phys. Chem. Chem. Phys. 4 (2002) 987–991, doi:10.1039/B109059C.
- [553] R.F. Inga, J.J. McKETTA, Solubility of Propyne in Water, J. Chem. Eng. Data. 6 (1961) 337–338, doi:10.1021/je00103a008.
- [554] J. McCurdy, D. Katz, Phase equilibria in the systems propylene-acetylene and propane-acetylene, Oil Gas J. 43 (1945) 102–104.
- [555] V. Mislavskaya, S. Khodeeva, Liquefied acetylene as solvent. II. the system acetylene-n-hexane, Russ. J. Phys. Chem. 43 (1969) 1062–1063.
- [556] R.J. Hogan, W.T. Nelson, G.H. Hanson, M.R. Cines, Ethane-ethylene-acetylene system - vapor-liquid equilibrium data at 35 °, 0° and 40 ° F, Ind. Eng. Chem. 47 (1955) 6.
- [557] W.A. McMillan, An azeotropic mixture of acetylene and ethane at atmospheric pressure, J. Am. Chem. Soc. 58 (1936) 1345, doi:10.1021/ja01299a009.
- [558] A.M. Clark, F. Din, Equilibria between solid, liquid and gaseous phases at low temperatures. The binary systems, acetylene carbon dioxide, acetylene ethylene and acetylene ethane, Trans. Faraday Soc. 46 (1950) 901–911, doi:10.1039/TF9504600901.
- [559] R. Kiyama, H. Hiraoka, The solubilities of compressed acetylene gas in liquids, III: the solubility of compressed acetylene gas in benzene, Rev. Phys. Chem. Jpn. 25 (1955) 52–57.
- [560] R.W. Potter, R.S. Babcock, G.K. Czamanske, An investigation of the critical liquid-vapor properties of dilute KCl solutions, J. Solut. Chem. 5 (1976) 223–230, doi:10.1007/BF00654339.
- [561] H. Hiraoka, The solubilities of compressed acetylene gas in liquids, I: the solubility of compressed acetylene gas in water, Rev. Phys. Chem. Jpn. 24 (1954) 13–18.
- [562] J.S. Lim, Y.-W. Lee, J.-D. Kim, Y.Y. Lee, J. Lee, Vapor-liquid equilibria for 1,1-difluoroethane + acetylene and 1,1-difluoroethane + 1,1-dichloroethane at 303.2 K and 323.2 K, J. Chem. Eng. Data. 41 (1996) 1168–1170, doi:10.1021/je960144m.
- [563] S.Y. Pavlov, L.L. Karpacheva, V.N. Korotkova, A.B. Kirnos, Combined phase equilibrium data of C<sub>4</sub>- and C<sub>5</sub>-hydrocarbon systems, IV. Azeotropy, Prom-St Sint Kauch. (1974) 1–3.
- [564] V.N. Korotkova, L.A. Bolkhova, L.L. Karpacheva, S.Y. Pavlov, L.A. Serafimov, L.S. Kofman, Vapor-liquid phase equilibrium in the binary mixtures containing C<sub>5</sub> hydrocarbons of the acetylene, Ser. Prom-St Sint Kauch. (1970) 1–3.
- [565] V.N. Korotkova, S.Y. Pavlov, L.L. Karpacheva, L.A. Serafimov, Vapor-liquid phase equilibrium in the binary mixtures containing C<sub>5</sub> hydrocarbons of the acetylene series, Prom-St Sint Kauch 6 (1969) 6–8.
- [566] E. Otsa, I. Kirjanen, L. Kudryavtseva, Study and calculation of liquid-vapor equilibrium in systems containing n-alkynes, Eesti NSV Tead Akad Toim Keem 28 (1979) 113–121.
- [567] K.E. Doering, H. Preuss, Vapor pressures of mixtures isoprene - 2-butylene (1968).
- [568] V.N. Korotkova, S.Y. Pavlov, L.L. Karpacheva, L.S. Kofman, L.A. Serafimov, Vapor-liquid phase equilibrium in binary mixtures containing C<sub>5</sub>-hydrocarbons of the acetylene series, III, Prom-St Sint Kauch. 3 (1971) 7–8.
- [569] A. Piña-Martinez, R. Privat, S. Lasala, G. Soave, J.-N. Jaubert, Search for the optimal expression of the volumetric dependence of the attractive contribution in cubic equations of state, Fluid Phase Equilibria 522 (2020) 112750, doi:10.1016/j.fluid.2020.112750.
- [570] A. Pina-Martinez, R. Privat, J.-N. Jaubert, D.-Y. Peng, Updated versions of the generalized Soave  $\alpha$ -function suitable for the Redlich-Kwong and Peng-Robinson equations of state, Fluid Phase Equilibria 485 (2019) 264–269, doi:10.1016/j.fluid.2018.12.007.
- [571] A. Piña-Martinez, R. Privat, J. Jaubert, Use of 300,000 pseudo-experimental data over 1800 pure fluids to assess the performance of four cubic equations of state: SRK, PR, *tc*-RK, and *tc*-PR, AIChE J 68 (2022) e17518, doi:10.1002/aic.17518.
- [572] G.M. Kontogeorgis, R. Privat, J.-N. Jaubert, Taking another look at the Van der Waals equation of state—almost 150 years later, J. Chem. Eng. Data. 64 (2019) 4619–4637, doi:10.1021/acs.jced.9b00264.
- [573] S. Bando, F. Takemura, M. Nishio, E. Hihara, M. Akai, Solubility of CO<sub>2</sub> in aqueous solutions of NaCl at (30 to 60) °c and (10 to 20) MPa, J. Chem. Eng. Data. 48 (2003) 576–579, doi:10.1021/je0255832.
- [574] J.B. Goodman, N.W. Krase, Solubility of nitrogen in water at high pressures and temperatures, Ind. Eng. Chem. 23 (1931) 401–404, doi:10.1021/ie50256a015.
- [575] V. Maslennikova, N. Vdovina, D. Tsiklis, Solubility of water in compressed nitrogen, Russ. J. Phys. Chem. 45 (1971) 1354.
- [576] T.D. O'Sullivan, N.O. Smith, B. Nagy, Solubility of natural gases in aqueous salt solutions—III nitrogen in aqueous NaCl at high pressures, Geochim. Cosmochim. Acta. 30 (1966) 617–619, doi:10.1016/0016-7037(66)90015-9.
- [577] N.O. Smith, S. Kelemen, B. Nagy, Solubility of natural gases in aqueous salt solutions—II: nitrogen in aqueous NaCl, CaCl<sub>2</sub>, Na<sub>2</sub>SO<sub>4</sub> and MgSO<sub>4</sub> at room temperatures and at pressures below 1000 psia, Geochim. Cosmochim. Acta. 26 (1962) 921–926, doi:10.1016/0016-7037(62)90066-2.
- [578] R. Wiebe, V.L. Gaddy, C. Heins, The Solubility of Nitrogen in Water at 50, 75 and 100° from 25 to 1000 Atmospheres, J. Am. Chem. Soc. 55 (1933) 947–953, doi:10.1021/ja01330a011.
- [579] P.C. Gillespie, G.M. Wilson, Vapor-liquid equilibrium data on water-substitute gas components: N<sub>2</sub>-H<sub>2</sub>O, H<sub>2</sub>-H<sub>2</sub>O, CO-H<sub>2</sub>O, H<sub>2</sub>-CO-H<sub>2</sub>O, and H<sub>2</sub>S-H<sub>2</sub>O, GPA Res. Rep. (1980) 1–34.
- [580] J. Alvarez, R. Fernández-Prini, A semiempirical procedure to describe the

- thermodynamics of dissolution of non-polar gases in water, *Fluid Phase Equilibria* 66 (1991) 309–326, doi:10.1016/0378-3812(91)85063-Z.
- [581] V. Maslennikova, *Solubility of Nitrogen in Water*, Tr Gos Nauchno Issled Proekt Inst Azotn Promst Prod Org Sin 12 (1971) 82–87.
- [582] A. Chapoy, A.H. Mohammadi, B. Tohidi, D. Richon, Gas solubility measurement and modeling for the nitrogen + water system from 274.18 K to 363.02 K, *J. Chem. Eng. Data* 49 (2004) 1110–1115, doi:10.1021/je049869d.
- [583] M.L. Japas, E.U. Franck, High pressure phase equilibria and PVT-data. of the water-nitrogen system to 673 K and 250 MPa, *Berichte Bunsenges. Für Phys. Chem.* 89 (1985) 793–800, doi:10.1002/bbpc.19850890714.
- [584] S.T. Blanco, I. Velasco, S. Otin, Dew points of binary nitrogen + water mixtures, *Phys. Chem. Liq.* 40 (2002) 167–172, doi:10.1080/00319100208086659.
- [585] A.H. Mohammadi, A. Chapoy, B. Tohidi, D. Richon, Water content measurement and modeling in the nitrogen + water system, *J. Chem. Eng. Data* 50 (2005) 541–545, doi:10.1021/je049676q.
- [586] V. Prokhorova, D. Tsiklis, Vapor-vapor equilibrium in the system nitrogen-water, *Zh. Fiz. Khim.* 44 (1970) 2069–2070.
- [587] M.P. Burgess, R.P. Germann, Physical properties of hydrogen sulfide-water mixtures, *AIChE J* 15 (1969) 272–275, doi:10.1002/aic.690150227.
- [588] F.T. Selleck, L.T. Carmichael, B.H. Sage, Phase Behavior in the Hydrogen Sulfide-Water System, *Ind. Eng. Chem.* 44 (1952) 2219–2226, doi:10.1021/ie50513a064.
- [589] J.I. Lee, A.E. Mather, Solubility of Hydrogen Sulfide in Water, *Berichte Bunsenges. Für Phys. Chem.* 81 (1977) 1020–1023, doi:10.1002/bbpc.19770811029.
- [590] J.J. Carroll, A.E. Mather, Phase equilibrium in the system water-hydrogen sulphide: experimental determination of the LLV locus, *Can. J. Chem. Eng.* 67 (1989) 468–470, doi:10.1002/cjce.5450670318.
- [591] T. Kozintseva, Solubility of H<sub>2</sub>S in Water and Salt- solutions a high Temperatures, *Sb Geokhim Issl Pov Davl Temp Mosk* (1965) 121–134.
- [592] A. Chapoy, A.H. Mohammadi, B. Tohidi, A. Valtz, D. Richon, Experimental measurement and phase behavior modeling of hydrogen sulfide-water binary system, *Ind. Eng. Chem. Res.* 44 (2005) 7567–7574, doi:10.1021/ie050201h.
- [593] P. Gillespie, G. Wilson, Sulfur compounds and water VLE and mutual solubility MeSH-H<sub>2</sub>O; EtSH-H<sub>2</sub>O; CS<sub>2</sub>-H<sub>2</sub>O and COS-H<sub>2</sub>O, *GPA Res. Rep. RR-78* (1984) 1–40 (n.d.).
- [594] V. Machát, T. Boublík, Vapour-liquid equilibrium at elevated pressures from the back equation of state. II. Binary systems, *Fluid Phase Equilibria* 21 (1985) 11–24, doi:10.1016/0378-3812(85)90057-3.
- [595] I.M. Elshayal, B.C.-Y. Lu, Measurement of total pressures for ethylene – propane mixtures, *Can. J. Chem. Eng.* 53 (1975) 83–87, doi:10.1002/cjce.5450530114.
- [596] P. Smith, Ph.D. thesis, University of Wisconsin, 1974.
- [597] P.R. Brown, J.B. Ott, L.R. Lemon, J.D. Moore, Excess molar enthalpies for (propane+ethene) over the temperature range from 273.15 K to 373.15 K and the pressure range from 5 MPa to 15 MPa, *J. Chem. Thermodyn.* 28 (1996) 905–921, doi:10.1006/jcht.1996.0080.
- [598] B. Williams, Ph.D. thesis, University of Michigan, 1947.
- [599] M. Raetzsch, W. Soell, *Z. Phys. Chem. Leipz.* 256 (1975) 815–828.
- [600] I. Nagy, R.A. Krenz, R.A. Heidemann, T.W. de Loos, Vapor-liquid equilibrium data for the ethylene + hexane system, *J. Chem. Eng. Data* 50 (2005) 1492–1495, doi:10.1021/je050120s.
- [601] B. Konobeev, V. Lyapin, *Khim Prom-St Mosc* 43 (1967) 114–116.
- [602] Confidential Company Research Report (1979).
- [603] T.P. Zhuze, A.S. Zhurba, Solubilities of ethylene in hexane, cyclohexane, and benzene under pressure, *Bull. Acad. Sci. USSR Div. Chem. Sci.* 9 (1960) 335–337, doi:10.1007/BF00942915.
- [604] T.P. Zhuze, A.S. Zhurba, E.A. Esakov, Solubilities of hexane, cyclohexane, and benzene in compressed ethylene, *Bull. Acad. Sci. USSR Div. Chem. Sci.* 9 (1960) 331–334, doi:10.1007/BF00942914.
- [605] W.B. Kay, Liquid-Vapor Equilibrium Relations in Binary Systems, *Ind. Eng. Chem.* 40 (1948) 1459–1464, doi:10.1021/ie50464a026.
- [606] C. Pacheco, J. Ferreira Filho, A. Uller, *Tokyo* (1986) 104–107.
- [607] I. Thoedtman, H. Preuss, D. Pape, *FIZ Rep.* (1989) 12011 (n.d.).
- [608] A. Sahgal, H.M. La, W. Hayduk, Solubility of ethylene in several polar and non-polar solvents, *Can. J. Chem. Eng.* 56 (1978) 354–357, doi:10.1002/cjce.5450560313.
- [609] V. Zernov, V. Kogan, O. Egudina, Phase Equilibria, Volume ratios in the systems heptane-ethylene, *J Appl. Chem. USSR* 63 (1990) 1469–1472.
- [610] G.W. Nederbragt, *Appl Sci Res A1* (1948) 237–248.
- [611] D.B. Todd, J.C. Elgin, Phase equilibria in systems with ethylene above its critical temperature, *AIChE J* 1 (1955) 20–27, doi:10.1002/aic.690010103.
- [612] J.V. Ribeiro, A.A. Susu, J.P. Kohn, Heterogeneous-phase equilibrium in ethylene-n-dodecane system, *J. Chem. Eng. Data* 17 (1972) 279–280, doi:10.1021/je60054a032.
- [613] T.W.D. Loos, W. Poot, R.N. Lichtenthaler, Fluid Phase Equilibria in Binary Ethylene + n-Alkane Systems, *Berichte Bunsenges. Für Phys. Chem.* 88 (1984) 855–859, doi:10.1002/bbpc.19840880916.
- [614] J.P. Kohn, E.S. Andrie, K.D. Luks, J.D. Colmenares, Phase equilibria of ethylene and certain normal paraffins, *J. Chem. Eng. Data* 25 (1980) 348–350, doi:10.1021/je60087a023.
- [615] J.S. Chou, K.-C. Chao, Solubility of ethylene in n-eicosane, n-octacosane, and n-hexatriacontane, *J. Chem. Eng. Data* 34 (1989) 68–70, doi:10.1021/je00055a019.
- [616] J. Gregorowicz, Solubility of eicosane in supercritical ethane and ethylene, *J. Supercrit. Fluids* 26 (2003) 95–113, doi:10.1016/S0896-8446(02)00158-4.
- [617] J. Gregorowicz, Phase behaviour in the vicinity of the three-phase solid-liquid-vapour line in asymmetric nonpolar systems at high pressures, *Fluid Phase Equilibria* 240 (2006) 29–39, doi:10.1016/j.fluid.2005.11.031.
- [618] A. Naumova, T. Tyvina, *Zh Prikl Khim Leningr* 54 (1981) 1416–1417.
- [619] A. Naumova, T. Tyvina, *J. Appl. Chem. USSR* 54 (1981) 2440–2441.
- [620] M. King, D. Alderson, F. Fallah, *Chem. Eng. Supercrit. Fluid Cond.* (1983) 31–80.
- [621] C. Hsi, B.C.-Y. Lu, Vapor-liquid equilibria in the methane-ethylene-ethane system, *Can. J. Chem. Eng.* 49 (1971) 140–143, doi:10.1002/cjce.5450490125.
- [622] D. Moran, Ph.D. thesis, University of London, 1959.
- [623] H. Sagara, Y. Arai, S. Saito, Vapor-Liquid Equilibria of Binary and Ternary Systems Containing Hydrogen and Light Hydrocarbons, *J. Chem. Eng. Jpn.* 5 (1972) 339–348, doi:10.1252/jcej.5.339.
- [624] J.C.G. Calado, V.A.M. Soares, Thermodynamics of liquid mixtures of methane and ethene, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases* 73 (1977) 1271–1280, doi:10.1039/F19777301271.
- [625] J.L. McCurdy, D.L. Katz, Phase equilibria in the system ethane-ethylene-acetylene, *Ind. Eng. Chem.* 36 (1944) 674–680, doi:10.1021/ie50415a017.
- [626] D.A. Barclay, J.L. Flebbe, D.B. Manley, Relative volatilities of the ethane-ethylene system from total pressure measurements, *J. Chem. Eng. Data* 27 (1982) 135–142, doi:10.1021/je00028a009.
- [627] G. Hanson, R. Hogan, F. Ruehlen, *Chem. Eng. Prog. Symp. Ser.* 49 (1953) 37–44.
- [628] P.T. Eubank, M.A. Barrufet, H. Duarte-Garza, L. Yurttas, PVT experiments for precise VLE data for mixtures of similar volatility, *Fluid Phase Equilibria* 52 (1989) 219–227, doi:10.1016/0378-3812(89)80328-0.
- [629] F. Kharakhorin, *Pet. Technol.* 9 (1941) 411–422.
- [630] A. Fredenslund, J. Mollerup, K.R. Hall, Vapor-liquid equilibrium data for the systems ethylene + ethane and carbon dioxide + ethylene + ethane, *J. Chem. Eng. Data* 21 (1976) 301–304, doi:10.1021/je60070a006.
- [631] J.C.G. Calado, E.J.S.G. de Azevedo, P. Clancy, K.E. Gubbins, Thermodynamic study of liquid mixtures of ethane and ethene, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases* 79 (1983) 2657–2667, doi:10.1039/F19837902657.
- [632] A.M. Clark, F. Din, Equilibria between solid, liquid and gaseous phases at low temperatures. the system carbon dioxide + ethane + ethylene, *Discuss. Faraday Soc.* 15 (1953) 202–207, doi:10.1039/DF9531500202.
- [633] M.S. Gruskiewicz, J.T. Sipowska, J.B. Ott, P.R. Brown, J.D. Moore, Excess enthalpies for (ethane+ethene) at the temperatures (273.15, 298.15, 323.15, 348.15, and 363.15) K and the pressures (5, 7.5, 10, 12.5, and 15) MPa, *J. Chem. Thermodyn.* 27 (1995) 507–524, doi:10.1006/jcht.1995.0052.
- [634] T. Liu, J.-Y. Fu, K. Wang, Y. Gao, W.-K. Yuan, Gas-Liquid Critical Properties of Ethylene + Benzene, *J. Chem. Eng. Data* 46 (2001) 809–812, doi:10.1021/je000309y.
- [635] S. Ellis, R. Valteris, G. Harris, *Chem Eng Progr Symp Ser* 64 (1968) 16–21.
- [636] G.A. Holder, D. Macauley, Solubility of ethylene in benzene at pressures to 9 MPa and temperatures from 353 to 433 K, *J. Chem. Eng. Data* 37 (1992) 100–104, doi:10.1021/je00005a026.
- [637] H. Hiraoka, *Rev. Phys. Chem. Jpn.* 28 (1958) 64–66.
- [638] Y. Kozorezov, A. Rusakov, N. Pikalo, *Khim Prom Mosc* 45 (1969) 343–345.
- [639] A. Zhurba, T. Zhuze, *Izv Vyssh Uchebn Zaved Neft Gaz* 1 (1960) 93–106.
- [640] S. Lyubetskii, *J. Appl. Chem. USSR* 35 (1962) 125–129.
- [641] S. Lyubetskii, *Zh Prikl Khim Peterburg Russ Fed* 35 (1962) 141–147.
- [642] D.L. Tiffin, J.P. Kohn, K.D. Luks, Three-phase solid-liquid-vapor equilibria of the systems ethylene-cyclohexane, ethylene-trans-decalin, ethylene-benzene, and ethylene-2-methylnaphthalene, *J. Chem. Eng. Data* 24 (1979) 96–98, doi:10.1021/je60081a019.
- [643] T. Tyvina, A. Naumova, S. Polyakov, *J Appl Chem USSR* 52 (1979) 910–913.
- [644] E. Shenderei, Y. Zel'vinskii, F. Ivanoskii, *Russ. J. Phys. Chem.* 36 (1962) 415–419.
- [645] E. Shenderei, Y. Zel'vinskii, F. Ivanoskii, *Zh. Fiz. Khim.* 36 (1962) 801–807.
- [646] L. Lee, H. Ou, H. Hsu, The experiments and correlations of the solubility of ethylene in toluene solvent, *Fluid Phase Equilibria* 231 (2005) 221–230, doi:10.1016/j.fluid.2005.02.010.
- [647] E. Nakamura, K. Koguchi, T. Amemiya, *Kogyo Kagaku Zasshi* 69 (1966) 1940–1944.
- [648] G.S.A. van Welie, G.A.M. Diepen, The P-T-x space model of the system ethylene-naphthalene (III), *Recl. Trav. Chim. Pays-Bas.* 80 (1961) 673–680, doi:10.1002/recl.19610800611.
- [649] Yu.V. Tsekanskaya, Solubility of naphthalene in ethylene and carbon dioxide under pressure, *Russ. J. Phys. Chem.* 38 (1964) 1173–1176.
- [650] K.P. Johnston, C.A. Eckert, An analytical Carnahan-Starling-van der Waals model for solubility of hydrocarbon solids in supercritical fluids, *AIChE J* 27 (1981) 773–779, doi:10.1002/aic.690270511.
- [651] G.A.M. Diepen, F.E.C. Scheffer, The Solubility of Naphthalene in Supercritical Ethylene, *J. Am. Chem. Soc.* 70 (1948) 4085–4089, doi:10.1021/ja01192a035.
- [652] G.A.M. Diepen, F.E.C. Scheffer, The Solubility of Naphthalene in Supercritical Ethylene, *J. Phys. Chem.* 57 (1953) 575–577, doi:10.1021/j150507a008.
- [653] S. Sako, K. Ohgaki, T. Katayama, Solubilities of naphthalene and indole in supercritical fluids, *J. Supercrit. Fluids* 1 (1988) 1–6, doi:10.1016/0896-8446(88)90003-4.
- [654] G.S.A. van Welie, G.A.M. Diepen, The P-T-x space model of the system ethylene-naphthalene (II), *Recl. Trav. Chim. Pays-Bas.* 80 (1961) 666–672, doi:10.1002/recl.19610800610.

- [655] R.T. Kurnik, S.J. Holla, R.C. Reid, Solubility of solids in supercritical carbon dioxide and ethylene, *J. Chem. Eng. Data*. 26 (1981) 47–51, doi:10.1021/je00023a016.
- [656] K.P. Johnston, D.H. Ziger, C.A. Eckert, Solubilities of hydrocarbon solids in supercritical fluids. The augmented van der Waals treatment, *Ind. Eng. Chem. Fundam.* 21 (1982) 191–197, doi:10.1021/i100007a001.
- [657] G.G. Haselden, F.A. Holland, M.B. King, R.F. Strickland-Constable, D.M. Newitt, Two-phase equilibrium in binary and ternary systems X. Phase equilibria and compressibility of the systems carbon dioxide/propylene, carbon dioxide/ethylene and ethylene/propylene, and an account of the thermodynamic functions of the system carbon dioxide/propylene, *Proc. R. Soc. Lond. Ser. Math. Phys. Sci.* 240 (1957) 1–28, doi:10.1098/rspa.1957.0063.
- [658] H.K. Bae, K. Nagahama, M. Hirata, Isothermal vapor-liquid equilibria for the ethylene-carbon dioxide system at high pressure, *J. Chem. Eng. Data*. 27 (1982) 25–27, doi:10.1021/je00027a007.
- [659] J. Mollerup, Vapour/liquid equilibrium in ethylene + carbon dioxide and ethane + carbon dioxide, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases*. 71 (1975) 2351–2360, doi:10.1039/f1975102351.
- [660] J.S. Rowlinson, J.R. Sutton, J.F. Weston, Liquid-vapor equilibrium in the ternary system carbon dioxide-nitrous oxide-ethylene, in: *Proc. Conf. Thermodyn. Transp. Prop. Fluids*, 1958, pp. 10–14. [https://scifinder.cas.org/scifinder/view/link\\_v1/reference.html?l=BmxXGlm8wGoFCPIy2rBde2fWid\\_6yPH3RX6YfMoH0E90M\\_T-ZM23w](https://scifinder.cas.org/scifinder/view/link_v1/reference.html?l=BmxXGlm8wGoFCPIy2rBde2fWid_6yPH3RX6YfMoH0E90M_T-ZM23w).
- [661] T. Hakuta, K. Nagahama, S. Suda, *Kagaku Kogaku* 33 (1969) 904–907.
- [662] N.E. Khazanova, E.E. Sominskaya, A.V. Zakharova, M.B. Rozovskii, N.L. Nechmailo, Systems with azetropism at high pressures. X. Phase and volume relations in the ethylene-carbon dioxide system, *Zh. Fiz. Khim.* 53 (1979) 1594–1597.
- [663] C.J. Wormald, J.M. Eyears, Excess molar enthalpies of (carbon dioxide + ethene) in the liquid and near-critical regions, *J. Chem. Thermodyn.* 33 (2001) 775–786, doi:10.1006/jcht.2000.0778.
- [664] S. Zeck, H. Knapp, Vapor – liquid and vapor – liquid – liquid phase equilibria of binary and ternary systems of nitrogen, ethene and methanol: Experiment and data evaluation, *Fluid Phase Equilibria* 26 (1986) 37–58, doi:10.1016/0378-3812(86)85003-8.
- [665] K.A.M. Gasem, M.J. Hiza, A.J. Kidnay, Phase behavior in the nitrogen + ethylene system from 120 to 200 K, *Fluid Phase Equilibria* 6 (1981) 181–189, doi:10.1016/0378-3812(81)85003-0.
- [666] L.B. Ba, S.C. Kaliaguine, R.S. Ramalho, Excess enthalpies for gaseous ethylene + nitrogen by flow calorimetry, *J. Chem. Thermodyn.* 10 (1978) 603–612, doi:10.1016/0021-9614(78)90100-3.
- [667] M. Hirata, T. Hakuta, *Mem Fac Technol Tokyo Metropol Univ* 18 (1968) 1595–1606.
- [668] T. Hakuta, K. Nagahama, M. Hirata, Binary Vapor-Liquid Equilibrium for C<sub>3</sub> Hydrocarbons, *Bull. Jpn. Pet. Inst.* 11 (1969) 10–15, doi:10.1627/jpi.1969.11.10.
- [669] A. Harmens, Propylene-propane phase equilibrium from 230 to 350 K, *J. Chem. Eng. Data*. 30 (1985) 230–233, doi:10.1021/je00040a032.
- [670] H.H. Reamer, B.H. Sage, Volumetric and phase behavior of propene-propane system, *Ind. Eng. Chem.* 43 (1951) 1628–1634, doi:10.1021/ie50499a043.
- [671] G.H. Hanson, R.J. Hogan, W.T. Nelson, M.R. Cines, Propane-propylene system – vapor-liquid equilibrium relationships, *Ind. Eng. Chem.* 44 (1952) 604–609, doi:10.1021/ie50507a048.
- [672] M. Hirata, T. Hakuta, T. Onoda, *Int. Chem. Eng.* 8 (1968) 175–179.
- [673] D.R. Laurance, G.W. Swift, Relative volatility of propane-propene system from 100–160 deg.F, *J. Chem. Eng. Data*. 17 (1972) 333–337, doi:10.1021/je60054a011.
- [674] G.W. Swift, D.B. Manley, Relative volatility of propane-propene system by integration of general coexistence equation, *J. Chem. Eng. Data*. 16 (1971) 301–307, doi:10.1021/je60050a016.
- [675] Q.N. Ho, K.S. Yoo, B.G. Lee, J.S. Lim, Measurement of vapor-liquid equilibria for the binary mixture of propylene (R-1270)+propane (R-290), *Fluid Phase Equilibria* 245 (2006) 63–70, doi:10.1016/j.fluid.2006.03.009.
- [676] J. Gmehling, *Unpubl. Data*. (2004).
- [677] E. Shenderoi, Y. Zel'venskii, F. Ivanovskii, *Tr Gos Nauchno IssledProektn Inst Azotn Promst Prod Org Sin* 15 (1963) 161–175.
- [678] H. Asatani, W. Hayduk, *World Congr. III Chem. Eng., Tokyo* (1986).
- [679] W. Hayduk, H. Asatani, Y. Miyano, Solubilities of propene, butane, isobutane and isobutene gases in n-octane, chlorobenzene and n-butanol solvents, *Can. J. Chem. Eng.* 66 (1988) 466–473, doi:10.1002/cjce.5450660318.
- [680] W. Hayduk, H. Asatani, Y. Miyano, A high pressure solubility apparatus for gases of high solubility (1991), doi:10.1002/CJCE.5450690520.
- [681] G.H. Goff, P.S. Farrington, B.H. Sage, Volumetric and Phase Behavior of Propene-1-Butene System, *Ind. Eng. Chem.* 42 (1950) 735–743, doi:10.1021/ie50484a045.
- [682] J. Oscarson, S. Lundell, J. Cunningham, *AIChE Symp Ser* 83 (1987) 1–17.
- [683] T.A. McFall, M.E. Post, J.J. Christensen, R.M. Izatt, The excess enthalpies of (1-butene + methyl t-butyl ether), (1,3-butadiene + propene), and (carbon disulfide + methanol) as functions of temperature, *J. Chem. Thermodyn.* 14 (1982) 509–515, doi:10.1016/0021-9614(82)90064-7.
- [684] B.H. Sage, W.N. Lacey, System 1-Butene-n-Butane, *Ind. Eng. Chem.* 40 (1948) 1299–1301, doi:10.1021/ie50463a027.
- [685] D.R. Laurance, G.W. Swift, Vapor-liquid equilibria in three binary and ternary systems composed of butane, 1-butene, and 1,3-butadiene, *J. Chem. Eng. Data*. 19 (1974) 61–67, doi:10.1021/je60060a008.
- [686] S. Laugier, D. Richon, High-Pressure Vapor-Liquid Equilibria for Ethylene + 4-Methyl-1-pentene and 1-Butene + 1-Hexene, *J. Chem. Eng. Data*. 41 (1996) 282–284, doi:10.1021/je9502509.
- [687] D. Wolfe, W.B. Kay, A.S. Teja, Phase equilibria in the n-pentane + pent-1-ene system. 2. dew and bubble points, *J. Chem. Eng. Data*. 28 (1983) 322–324, doi:10.1021/je00033a011.
- [688] B. Marrufo, A. Aucejo, M. Sanchoello, S. Loras, Isobaric vapor-liquid equilibrium for binary mixtures of 1-hexene+n-hexane and cyclohexane+cyclohexene at 30, 60 and 101.3kPa, *Fluid Phase Equilibria* 279 (2009) 11–16, doi:10.1016/j.fluid.2008.12.007.
- [689] W. Wóycicki, Excess enthalpies of binary mixtures containing unsaturated aliphatic hydrocarbons 1. n-Alkene + n-alkane, *J. Chem. Thermodyn.* 7 (1975) 77–81, doi:10.1016/0021-9614(75)90083-X.
- [690] J.J. Segovia, M.C. Martín, C.R. Chamorro, E.A. Montero, M.A. Villamañán, Excess thermodynamic functions for ternary systems containing fuel oxygenates and substitution hydrocarbons: 2. Total-pressure data and GE for methyl tert-butyl ether/n-heptane/1-hexene at 313.15 K This paper is part of the doctoral thesis of J.J. Segovia, *Fluid Phase Equilibria* 152 (1998) 265–276, doi:10.1016/S0378-3812(98)00384-7.
- [691] H. Segura, J. Wisniak, G. Galindo, R. Reich, Phase Equilibria in the Systems 1-Hexene + Heptane and 1-Hexene + Ethyl 1,1-Dimethylethyl Ether + Heptane at 94.00 kPa, *Phys. Chem. Liq.* 40 (2002) 67–81, doi:10.1080/00319100208086650.
- [692] L. Kudryavtseva, M. Kuus, H. Viit, Excess enthalpy. 1-Heptene - heptane system, *Int. Data Ser. Sel. Data Mix. Ser. A*. 1 (1981) 13–16.
- [693] L. Kudryavtseva, M. Toome, E. Otsa, *Eesti NSV Tead Akad Toim Keem* 30 (1981) 147–149.
- [694] M. Wóycicki, Excess enthalpies of dilute solutions of n-propanol with unsaturated hydrocarbons, *Bull. Acad. Pol. Sci. Ser. Sci. Chim.* 31 (1983) 107–112.
- [695] M. Kuus, L. Kudryavtseva, Thermodynamic properties of mixtures of n-octane with isomers of n-octene. 1. Heats of mixing, *Eesti NSV Tead Akad Toim Keem* 29 (1980) 25–31.
- [696] M. Kuus, M. Toome, L. Kudryavtseva, *Eesti NSV Tead Akad Toim Keem* 29 (1980) 32–37.
- [697] A.H. Jalili, M. Sina, Isobaric Vapor-Liquid Equilibria of Hexane + 1-Decene and Octane + 1-Decene Mixtures, *J. Chem. Eng. Data*. 53 (2008) 398–402, doi:10.1021/je700445y.
- [698] B. Pittau, B. Marongiu, S. Porcedda, Thermodynamics of binary mixtures containing alkenes. 1. Excess enthalpies of some alkenes and polyenes + n-heptane or cyclohexane mixtures, *J. Chem. Eng. Data*. 37 (1992) 124–126, doi:10.1021/je00005a032.
- [699] P.C. Joyce, B.E. Leggett, M.C. Thies, Vapor-liquid equilibrium for model Fischer-Tropsch waxes (hexadecane, 1-hexadecene, and 1-hexadecanol) in supercritical hexane, *Fluid Phase Equilibria* 158–160 (1999) 723–731, doi:10.1016/S0378-3812(99)00108-9.
- [700] J.R. Keistler, M.V. Winkle, Vapor-liquid equilibria at subatmospheric pressures -system dodecane hexadecene, *Ind. Eng. Chem.* 44 (1952) 622–624, doi:10.1021/ie50507a052.
- [701] R.R. Rasmussen, M.V. Winkle, Vapor-liquid equilibria at subatmospheric pressures. tetradecane- hexadecane system, *Ind. Eng. Chem.* 42 (1950) 2121–2124, doi:10.1021/ie50490a032.
- [702] S.H. Ward, M.V. Winkle, Vapor-Liquid Equilibria at 200 Mm, of Mercury, *Ind. Eng. Chem.* 46 (1954) 338–350, doi:10.1021/ie50530a037.
- [703] B.T. Jordan, M.V. Winkle, Vapor-Liquid Equilibria at Subatmospheric Pressures. Dodecane-Octadecene System, *Ind. Eng. Chem.* 43 (1951) 2908–2912, doi:10.1021/ie50504a067.
- [704] K. Doering, H. Preuss, *FIZ Rep.* (1967) 3061 (n.d.).
- [705] M. Rozhnov, *Khim Prom-St Mosc* 43 (1967) 288–290.
- [706] M. Rozhnov, G. Efreanova, *Khim Prom Ukr* 6 (1970) 33–35.
- [707] J.L. Flebbe, D.A. Barclay, D.B. Manley, Vapor pressures of some C<sub>4</sub> hydrocarbons and their mixtures, *J. Chem. Eng. Data*. 27 (1982) 405–412, doi:10.1021/je00030a011.
- [708] K. Doering, H. Preuss, *FIZ Rep.* (1967) 4141 (n.d.).
- [709] J. Li, Z. Qin, G. Wang, M. Dong, J. Wang, Critical temperatures and pressures of several binary and ternary mixtures concerning the alkylation of 2-methylpropane with 1-butene in the presence of methane or carbon dioxide, *J. Chem. Eng. Data*. 52 (2007) 1736–1740, doi:10.1021/je700132w.
- [710] K. Steele, B.E. Poling, D.B. Manley, Vapor pressures for the system 1-butene, isobutane, and 1,3-butadiene, *J. Chem. Eng. Data*. 21 (1976) 399–403, doi:10.1021/je60071a006.
- [711] I. Thoedtman, H. Preuss, D. Pape, *FIZ Rep.* (1989) 9151 (n.d.).
- [712] C. Wohlfarth, U. Finck, R. Schultz, T. Heuer, Investigation of phase equilibria in mixtures composed of ethene, 1-butene, 4-methyl-1-pentene and a polyethylene wax, *Angew. Makromol. Chem.* 198 (1992) 91–110, doi:10.1002/apmc.1992.051980109.
- [713] C.R. Chamorro, M.C. Martín, M.A. Villamañán, J.J. Segovia, Characterization and modelling of a gasoline containing 1,1-dimethylethyl methyl ether (MTBE), diisopropyl ether (DIPE) or 1,1-dimethylpropyl methyl ether (TAME) as fuel oxygenate based on new isothermal binary vapour-liquid data, *Fluid Phase Equilibria* 220 (2004) 103–110, doi:10.1016/j.fluid.2004.02.013.
- [714] H. Segura, J. Wisniak, G. Galindo, R. Reich, Phase Equilibria in the Systems 1-Hexene + 2,2,4-Trimethylpentane and 1-Hexene + Ethyl 1,1-Dimethylethyl Ether + 2,2,4-Trimethylpentane at 94.00 kPa, *J. Chem. Eng. Data*. 46 (2001) 511–515, doi:10.1021/je000096c.
- [715] Z. Wang, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of binary mixtures of 1-hexene with some branched alkanes at the temperature 298.15 K, *J. Chem. Thermodyn.* 36 (2004) 45–47, doi:10.1016/j.jct.2003.09.004.

- [716] R. Popescu, L. Stanescu, D. Sandulescu, *Rev. Roum. Chim.* 37 (1992) 1117–1124.
- [717] N. Orobinskii, Y. Blagoi, E. Semyannikova, *Fiz Khim Rastvorov* (1972) 233–238.
- [718] Y. Blagoi, N. Orobinskii, *Russ. J. Phys. Chem.* 40 (1966) 1625–1629.
- [719] V. Sandri, *Corsi Semin Chim* 5 (1967) 63–71.
- [720] R.A. McKay, H.H. Reamer, B.H. Sage, W.N. Lacey, Volumetric and phase behavior in the ethane-propene system, *Ind. Eng. Chem.* 43 (1951) 2112–2117, doi:10.1021/ie50501a039.
- [721] K. Ohgaki, S. Nakai, S. Nitta, T. Katayama, Isothermal vapor-liquid equilibria for the binary systems propylene-carbon dioxide, propylene-ethylene and propylene-ethane at high pressure, *Fluid Phase Equilibria* 8 (1982) 113–122, doi:10.1016/0378-3812(82)80029-0.
- [722] H. Lu, D.M. Newitt, M. Ruhemann, A.C. Egerton, IV. the system ethane-propylene, *Proc. R. Soc. Lond. Ser. Math. Phys. Sci.* 178 (1941) 506–525, doi:10.1098/rspa.1941.0072.
- [723] M. Hirata, S. Suda, T. Hakuta, K. Nagahama, Light hydrocarbon vapor-liquid equilibria, *Mem. Fac. Technol. Tokyo Metropol. Univ.* 19 (1969) 103–122.
- [724] G. Wang, Z. Qin, J. Liu, Z. Tian, X. Hou, J. Wang, Critical properties of the reacting mixture in the alkylation of benzene with propene, *Ind. Eng. Chem. Res.* 42 (2003) 6531–6535, doi:10.1021/ie030480d.
- [725] H. Yamamoto, K. Ohgaki, T. Katayama, Isothermal vapour-liquid equilibrium data of the benzene-propylene system at 25°C, *Fluid Phase Equilibria* 46 (1989) 53–58, doi:10.1016/0378-3812(89)80274-2.
- [726] O. Guzechak, V. Sarancha, I. Romanyuk, *J. Appl. Chem. USSR* 57 (1984) 1662–1665.
- [727] Y. Kozorezov, T. Novozhilova, *Sov. Chem. Ind. Engl. Transl.* 47 (1971) 399–401.
- [728] J. Guo, T. Liu, Y.-C. Dai, W.-K. Yuan, Vapor-liquid equilibria of benzene and propylene under elevated temperature and pressure, *J. Chem. Eng. Data.* 46 (2001) 668–670, doi:10.1021/je0002179.
- [729] Y. Miyano, K. Nakanishi, Solubilities of 1-butene in (methanol+benzene) and (methanol+cyclohexane) at  $T=298.15\text{K}$  and  $p=40\text{kPa}$  to  $102\text{kPa}$ , *J. Chem. Thermodyn.* 35 (2003) 519–528, doi:10.1016/S0021-9614(02)00368-3.
- [730] K.F. Wong, C.A. Eckert, Vapor-liquid equilibria of 1,3-butadiene systems, *J. Chem. Eng. Data.* 14 (1969) 432–436, doi:10.1021/je60043a025.
- [731] J.M. Prausnitz, J.H. Vera, Vapor-liquid equilibria in binary aromatic-olefin systems, *J. Chem. Eng. Data.* 16 (1971) 149–154, doi:10.1021/je60049a012.
- [732] C.R. Chamorro, J.J. Segovia, M.C. Martín, M.A. Villamañán, Thermodynamics of Octane-Enhancing Additives in Gasolines: Vapor-Liquid Equilibrium of Ternary Mixtures Containing Di-isopropyl Ether or Cyclohexane and 1-Hexene + Benzene at 313.15 K, *J. Chem. Eng. Data.* 47 (2002) 316–321, doi:10.1021/je0102210.
- [733] J. Dojčanský, J. Heinrich, J. Surový, *Chem Zvesti* 21 (1967) 713–717.
- [734] H. Segura, J. Wisniak, G. Galindo, R. Reich, Phase Equilibria in the Systems 1-Hexene + Benzene and 1-Hexene + Ethyl 1,1-Dimethylethyl Ether + Benzene at 94.00 kPa, *J. Chem. Eng. Data.* 46 (2001) 506–510, doi:10.1021/je000165n.
- [735] M. Karbalai Ghassem, J. Grolier, Excess enthalpy. Benzene-1-hexene system, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1975) 186–190.
- [736] Z. Wang, G.C. Benson, B.C.-Y. Lu, Excess molar enthalpies of binary mixtures of 1-hexene with some cyclic and aromatic hydrocarbons at 298.15K, *Thermochim. Acta.* 414 (2004) 31–33, doi:10.1016/j.tca.2003.10.010.
- [737] T.M. Letcher, R.C. Baxter, Excess enthalpies and excess volumes of (benzene or cyclohexane or n-hexane + an alkene or an alkyne) at 298.15 K, *J. Chem. Thermodyn.* 19 (1987) 321–326, doi:10.1016/0021-9614(87)90140-6.
- [738] M. Kuus, L. Kudryavtseva, H. Kirss, Heats of mixing of n-octene isomers with some organic compounds, *Eesti NSV Tead Akad Toim Keem* 31 (1982) 54–57.
- [739] C. Dariiva, H. Lovisi, L.C.S. Mariac, F.M.B. Coutinho, J.V. Oliveira, J.C. Pinto, Propylene solubility in toluene and isododecane, *Can. J. Chem. Eng.* 81 (2003) 147–152, doi:10.1002/cjce.5450810119.
- [740] C. Díaz, A. Dominguez, J. Tojo, Phase Equilibria of the Binary Systems 1-Hexene with o-Xylene, m-Xylene, p-Xylene, Toluene, and Ethylbenzene at 101.3 kPa, *J. Chem. Eng. Data.* 47 (2002) 867–871, doi:10.1021/je010295b.
- [741] B.C.-Y. Lu, L.-W. Ni, M. Taylor, Reevaluation of vapor-liquid equilibria for butadiene + styrene, *J. Chem. Eng. Data.* 41 (1996) 287–291, doi:10.1021/je9502197.
- [742] R.H. Wilhelm, D.W. Collier, Vapor-liquid equilibria of the system butadiene-styrene, *Ind. Eng. Chem.* 40 (1948) 2350–2353, doi:10.1021/ie50468a026.
- [743] N. Laevskaya, I. Bagrov, L. Dobroserdov, Deposited Doc VINITI (1977) 1–7.
- [744] Confidential Company Research Report (1977).
- [745] L. Kudryavtseva, M. Kuus, H. Kirss, Effect of molecular structure on the excess enthalpies of mixtures with unsaturated hydrocarbons, *Eesti NSV Tead Akad Toim Keem* 38 (1989) 84–92.
- [746] P. Chaiyavech, M. Van Winkle, Styrene-Ethylbenzene Vapor-Liquid Equilibria at Reduced Pressures, *J. Chem. Eng. Data.* 4 (1959) 53–56, doi:10.1021/je60001a008.
- [747] A. Aucejo, S. Loras, V. Martínez-Soria, N. Becht, G. Del Río, Isobaric vapor-liquid equilibria for the binary mixtures of styrene with ethylbenzene, o-xylene, m-xylene, and p-xylene, *J. Chem. Eng. Data.* 51 (2006) 1051–1055, doi:10.1021/je050523s.
- [748] W. Junghans, U. von Weber, Das binäre system äthylbenzol-styrol. dampf-flüssigkeit-gleichgewichte bei 30, 60, 90 und 120°C nach einer mitführungsmethode und mischungswärmen bei 20°C, *J. Für Prakt. Chem.* 2 (1955) 265–273, doi:10.1002/prac.19550020501.
- [749] W.L. Martin, M.V. Winkle, Vapor-liquid equilibria of naphthalene-octadecene system at subatmospheric pressures, *Ind. Eng. Chem.* 46 (1954) 1477–1481, doi:10.1021/ie50535a047.
- [750] J. Ke, B. Han, M.W. George, H. Yan, M. Poliakoff, How does the critical point change during a chemical reaction in supercritical fluids? a study of the hydroformylation of propene in supercritical CO<sub>2</sub>, *J. Am. Chem. Soc.* 123 (2001) 3661–3670, doi:10.1021/ja003446o.
- [751] M. Yorizane, S. Yoshimura, H. Masuoka, *Kagaku Kogaku* 30 (1966) 1093–1096.
- [752] G.G. Haselden, D.M. Newitt, S.M. Shah, Two-Phase equilibrium in binary and ternary systems. V. carbon dioxide-ethylene. VI. carbon dioxide-propylene, *Proc. R. Soc. Math. Phys. Eng. Sci.* 209 (1951) 1–14, doi:10.1098/rspa.1951.0183.
- [753] K.-D. Wagner, J. Zappe, A. Reeps, N. Dahmen, E. Dinjus, Vapor-liquid equilibria for the binary system of carbon dioxide and 1,3-butadiene at 303, 313 and 333 K, *Fluid Phase Equilibria* 153 (1998) 135–142, doi:10.1016/S0378-3812(98)00404-X.
- [754] G.-W. Wu, N.-W. Zhang, X.-Y. Zheng, H. Kubota, T. Makita, High pressure vapor-liquid equilibria of four binary systems containing carbon dioxide, *J. Chem. Eng. Jpn.* 21 (1988) 25–29, doi:10.1252/jcej.21.25.
- [755] H.-S. Byun, T.-H. Choi, Vapor-Liquid equilibria measurement of carbon dioxide+1-hexene and carbon dioxide+2-ethyl-1-butene systems at high pressure, *Korean J. Chem. Eng.* 21 (2004) 1032–1037, doi:10.1007/BF02705589.
- [756] D.W. Jennings, A.S. Teja, Vapor-liquid equilibria in the carbon dioxide-1-hexene and carbon dioxide-1-hexyne systems, *J. Chem. Eng. Data.* 34 (1989) 305–309, doi:10.1021/je00057a014.
- [757] W. Ren, B. Rutz, A.M. Scurto, High-pressure phase equilibrium for the hydroformylation of 1-octene to nonanal in compressed CO<sub>2</sub>, *J. Supercrit. Fluids.* 51 (2009) 142–147, doi:10.1016/j.supflu.2009.08.003.
- [758] G.J. Suppes, M.A. McHugh, Phase behavior of the carbon dioxide-styrene system, *J. Chem. Eng. Data.* 34 (1989) 310–312, doi:10.1021/je00057a015.
- [759] M. Akgün, D. Emel, N. Baran, N.A. Akgün, S. Deniz, S. Dinçer, Styrene-carbon dioxide phase equilibria at high pressures, *J. Supercrit. Fluids.* 31 (2004) 27–32, doi:10.1016/j.supflu.2003.09.019.
- [760] H. Kim, H. Lin, K. Chao, *AIChE Symp. Ser.* 81 (1985) 86–89.
- [761] H. Kubota, H. Inatome, Y. Tanaka, T. Makita, Vapor-liquid equilibria of the ethylene-propylene system under high pressure, *J. Chem. Eng. Jpn.* 16 (1983) 99–103, doi:10.1252/jcej.16.99.
- [762] H.K. Bae, K. Nagahama, M. Hirata, Measurement and correlation of high pressure vapor-liquid equilibria for the systems ethylene-1-butene and ethylene-propylene, *J. Chem. Eng. Jpn.* 14 (1981) 1–6, doi:10.1252/jcej.14.1.
- [763] Confidential Company Research Report (1982).
- [764] H. Preuss, K. Moerke, *FIZ Rep.* (1984).
- [765] S. Laugier, D. Richon, H. Renon, Ethylene + olefin binary systems: vapor-liquid equilibrium experimental data and modeling, *J. Chem. Eng. Data.* 39 (1994) 388–391, doi:10.1021/je00014a045.
- [766] Confidential Company Research Report (1981).
- [767] A.F. Burcham, M.D. Trampe, B.E. Poling, D.B. Manley, Phase equilibria for the propane-propadiene system from total pressure measurements, *Equ. State, Am. Chem. Soc.* (1986) 86–107, doi:10.1021/bk-1986-0300.ch004.
- [768] C.S. Howat, G.W. Swift, Vapor-liquid phase equilibria for the isoprene-n-pentane binary system from 300 to 330 K, *Fluid Phase Equilibria* 21 (1985) 113–134, doi:10.1016/0378-3812(85)90063-9.
- [769] A. Kozhenkov, Y. Malenko, S. Nikolaev, *Promst Sint KauchShin Rezinotekh Izdel* 7 (1988) 2–3.
- [770] A. Kozhenkov, Y. Malenko, S. Nikolaev, *Promst Sint KauchShin Rezinotekh Izdel* 1 (1987) 3–4.
- [771] F. Royo, M. Gracia, C. Gutierrez, Thermodynamic Study of Some Binary Mixtures and Energy Parameters of the Various Types of Contacts involved, *Rev Acad Cienc Exact Fis Quim Nat Zaragoza* 37 (1982) 51–59.
- [772] A. Kozhenkov, S. Nikolaev, D. Sobolev, *Promst Sint KauchShin Rezinotekh Izdel* 11 (1987) 4–5.
- [773] K. Doering, H. Preuss, *FIZ Rep.* (1967) 2041 (n.d.).
- [774] Z. Mervart, Phasengleichgewichte im system isobuten-isopren bei 5 atm, *Collect. Czechoslov. Chem. Commun.* 24 (1959) 4034–4036, doi:10.1135/cccc19594034.
- [775] Z. Wu, Z. Chen, Z. Shou, *Huagong Xuebao Chin. Ed.* 38 (1987) 406–415.
- [776] K. Doering, H. Preuss, *FIZ Rep.* (1968) 7091 (n.d.).
- [777] J.N. Ezekwe, C.S. Howat, G.W. Swift, Vapor-liquid equilibria for the binary system 2-methylbutene-2 and 2-methyl-1,3-butadiene at 310.93, 316.48 and 322.04 K, *Fluid Phase Equilibria* 7 (1981) 75–85, doi:10.1016/0378-3812(81)87007-0.
- [778] L. Shestakova, L. Kofman, T. Matveeva, *Prom Sin Kauch Nauch -Tekh Sb* 11 (1970) 10–13.
- [779] Z. Dolejšek, O. Grubner, E. Hala, *Chem. Prum.* 11 (1961) 361–363.
- [780] A. Frolov, V. Korotkova, *Khim Promst Mosc* (1961) 376–378.
- [781] S.K. Ogorodnikov, V.B. Kogan, M. Nemtsov, *J Appl Chem USSR* 33 (1960) 1581–1587.
- [782] V. Korotkova, S. Pavlov, L. Karpacheva, *Promst Sint Kauch* (1971) 1–4.
- [783] Z. Lianzhou, *Huaxue Gongcheng* 3 (1973) 110–120.
- [784] A. Kozhenkov, S. Nikolaev, L. Reshetova, *Proizv. Ispolz Elastom.* (1991) 8–12.
- [785] V. Vostrikova, T. Moiseeva, A. Grinfeld, *Promst Sint Kauch Shin Rezinotekh Izdel* 12 (1986) 2–4.
- [786] E. Shenderei, *Khim Promst Mosc* 41 (1965) 580–585.
- [787] H.W. Scheeline, E.R. Gilliland, Vapor-Liquid Equilibrium in the System



- Propane-Isobutylene, *Ind. Eng. Chem.* 31 (1939) 1050–1057, doi:[10.1021/je50356a026](https://doi.org/10.1021/je50356a026).
- [788] M. Hirata, S. Suda, T. Hakuta, K. Nagahama, High Pressure Vapor-Liquid Equilibria for Binary System Containing C<sub>4</sub>-Hydrocarbons, *J. Jpn. Pet. Inst.* 12 (1969) 773–777, doi:[10.1627/jpii1958.12.773](https://doi.org/10.1627/jpii1958.12.773).
- [789] J.D. Moore, P.R. Brown, J.B. Ott, Excess molar enthalpies and excess molar volumes for the binary mixtures of 2-methylpropane, 2-methylpropene, and propane-2-ol at the temperatures (298.15 and 323.15) K and the pressures (5, 10, and 15) MPa, *J. Chem. Thermodyn.* 29 (1997) 179–195, doi:[10.1006/jcht.1996.0147](https://doi.org/10.1006/jcht.1996.0147).
- [790] K. Doering, H. Preuss, *FIZ Rep.* (1968) 1221 (n.d.).
- [791] S. Prikhodko, L. Komarova, O. Gorelova, *Zh Prikl Khim Leningr* 78 (2005) 403–407.
- [792] V.T. Bui, A. Hamdouni, J. Léonard, Interactive behaviour of the  $\alpha$ -methylstyrene-toluene mixture, *Can. J. Chem. Eng.* 70 (1992) 153–158, doi:[10.1002/cjce.5450700122](https://doi.org/10.1002/cjce.5450700122).
- [793] R. Reich, V. Sanhueza, Vapor-liquid equilibria for  $\alpha$ -pinene and  $\beta$ -pinene and for these pinenes with heptane, cyclohexane, 1-octene and cyclohexene, *Fluid Phase Equilibria* 77 (1992) 313–325, doi:[10.1016/0378-3812\(92\)85111-K](https://doi.org/10.1016/0378-3812(92)85111-K).
- [794] H.-S. Phiong, F.P. Lucien, Volumetric expansion and vapour-liquid equilibria of  $\alpha$ -methylstyrene and cumene with carbon dioxide at elevated pressure, *J. Supercrit. Fluids*. 25 (2003) 99–107, doi:[10.1016/S0896-8446\(02\)00097-9](https://doi.org/10.1016/S0896-8446(02)00097-9).
- [795] E. Bogel-Lukasik, A. Szudarska, R. Bogel-Lukasik, M. Nunes da Ponte, Vapour-liquid equilibrium for  $\beta$ -myrcene and carbon dioxide and/or hydrogen and the volume expansion of  $\beta$ -myrcene or limonene in CO<sub>2</sub> at 323.15K, *Fluid Phase Equilibria* 282 (2009) 25–30, doi:[10.1016/j.fluid.2009.04.020](https://doi.org/10.1016/j.fluid.2009.04.020).
- [796] M.A.M. Costa, H.A.S. Matos, M. Nunes da Ponte, E.J.S. Gomes de Azevedo, Binary and ternary phase behavior of  $\alpha$ -pinene,  $\beta$ -pinene, and supercritical ethene, *J. Chem. Eng. Data.* 41 (1996) 1104–1110, doi:[10.1021/je960119g](https://doi.org/10.1021/je960119g).
- [797] M. Diaz Peña, B. Espino, R. Perez, Excess enthalpies of cyclohexene + n-alkanes, *Bol. Soc. Quim. Peru* 50 (1984) 64–68.
- [798] B. Ruiz, T. Fernandez, *ELDATA Int. Electron. J. Phys. Chem. Data* 5 (1999) 143–148.
- [799] V. Vostrikova, E. Ambrozaitis, L. Savostina, *J Appl Chem USSR* 55 (1982) 1178–1179.
- [800] D.S. Jan, Y.C. Xie, F.N. Tsai, Isobaric vapor-liquid equilibria for cyclopentane + cyclohexene + 1,2-dichloroethane and the three constituent binary systems, *J. Chem. Eng. Data.* 38 (1993) 383–385, doi:[10.1021/je00011a012](https://doi.org/10.1021/je00011a012).
- [801] R. Stryjek, S. Bobbo, R. Camporese, Isothermal Vapor-Liquid Equilibria for 1,1,1,2-Tetrafluoroethane + Propane and Propane + 1,1,1-Trifluoroethane at 283.18 K, *J. Chem. Eng. Data.* 43 (1998) 241–244, doi:[10.1021/je970191u](https://doi.org/10.1021/je970191u).
- [802] J.S. Lim, J.-Y. Park, J.W. Kang, B.-G. Lee, Measurement of vapor-liquid equilibria for the binary systems of propane+1,1,1,2-tetrafluoroethane and 1,1,1-trifluoroethane+propane at various temperatures, *Fluid Phase Equilibria* 243 (2006) 57–63, doi:[10.1016/j.fluid.2006.02.016](https://doi.org/10.1016/j.fluid.2006.02.016).
- [803] R. Jadot, M. Frere, Simulation of liquid-vapor equilibria of hydrofluorocarbon (HFC) mixtures by the UNIFAC model, 25, *High Temp -High Press*, 1993, pp. 491–501.
- [804] C.D. Holcomb, J.W. Magee, J.L. Scott, S.L. Outcalt, W.M. Haynes, 1997.
- [805] J. Im, M. Kim, B.-G. Lee, H. Kim, Vapor-Liquid Equilibria of the Binary n-Butane (HC-600) + Difluoromethane (HFC-32), + Pentafluoroethane (HFC-125), + 1,1,1,2-Tetrafluoroethane (HFC-134a) Systems, *J. Chem. Eng. Data.* 50 (2005) 359–363, doi:[10.1021/je049817o](https://doi.org/10.1021/je049817o).
- [806] A. Kordikowski, D.G. Robertson, A.I. Aguiar-Ricardo, V.K. Popov, S.M. Howdle, M. Poliakoff, Probing Vapor/Liquid Equilibria of Near-Critical Binary Gas Mixtures by Acoustic Measurements, *J. Phys. Chem.* 100 (1996) 9522–9526, doi:[10.1021/jp960010f](https://doi.org/10.1021/jp960010f).
- [807] C. Duran-Valencia, G. Pointurier, A. Valtz, P. Guilbot, D. Richon, Vapor-Liquid Equilibrium (VLE) Data for the Carbon Dioxide (CO<sub>2</sub>) + 1,1,1,2-Tetrafluoroethane (R134a) System at Temperatures from 252.95 K to 292.95 K and Pressures up to 2 MPa, *J. Chem. Eng. Data.* 47 (2002) 59–61, doi:[10.1021/je010075y](https://doi.org/10.1021/je010075y).
- [808] G. Silva-Oliver, L.A. Galicia-Luna, Vapor-liquid equilibria for carbon dioxide + 1,1,1,2-tetrafluoroethane (R-134a) systems at temperatures from 329 to 354 K and pressures up to 7.37 MPa, *Fluid Phase Equilibria* 199 (2002) 213–222, doi:[10.1016/S0378-3812\(01\)00816-0](https://doi.org/10.1016/S0378-3812(01)00816-0).
- [809] Q.N. Ho, B.G. Lee, J.-Y. Park, J.-D. Kim, J.S. Lim, Measurement of vapor-liquid equilibria for the binary mixture of propylene (R-1270) + 1,1,1,2-tetrafluoroethane (HFC-134a), *Fluid Phase Equilibria* 225 (2004) 125–132, doi:[10.1016/j.fluid.2004.08.028](https://doi.org/10.1016/j.fluid.2004.08.028).
- [810] G. Di Nicola, F. Polonara, R. Stryjek, P-V-T-x and Vapor-Liquid Equilibrium Properties of Pentafluoroethane (R125) + 1,1,1,3,3,3-Hexafluoroethane (R236fa) and 1,1,1,2-Tetrafluoroethane (R134a) + R236fa Systems Derived from Isochoric Measurements, *J. Chem. Eng. Data.* 46 (2001) 359–366, doi:[10.1021/je000259x](https://doi.org/10.1021/je000259x).
- [811] D. Arnaud, J.-C. Tanguy, D. Sallet, Azetrop blending, DK0427604T3, 1993. <https://patents.google.com/patent/DK0427604T3/da> (accessed August 8, 2021).
- [812] Y. Shi, K. Wang, H. Liu, Y. Hu, Measurement of vapor-liquid equilibria for 1, 1, 1, 2-tetrafluoroethane-1, 1-difluoroethane binary system, *Huadong Ligong Daxue Xuebao* 21 (1995) 613–618.
- [813] R. Tillner-Roth, An experimental study of the thermodynamic properties of the refrigerant mixture: {1,1,1,2-tetrafluoroethane (R 134a)+1,1-difluoroethane (R 152a)}, *J. Chem. Thermodyn.* 25 (1993) 1419–1441, doi:[10.1006/jcht.1993.1144](https://doi.org/10.1006/jcht.1993.1144).
- [814] L.C. Widdoes, D.L. Katz, Vapor-Liquid Equilibrium Constants for Carbon Monoxide, *Ind. Eng. Chem.* 40 (1948) 1742–1746, doi:[10.1021/ie50465a030](https://doi.org/10.1021/ie50465a030).
- [815] D. Trust, Ph.D. Thesis, Kansas University, 1968.
- [816] D.B. Trust, F. Kurata, Vapor-liquid and liquid-liquid vapor phase behavior of the carbon monoxide-propane and the carbon monoxide-ethane systems, *AIChE J.* 17 (1971) 415–419, doi:[10.1002/aic.690170232](https://doi.org/10.1002/aic.690170232).
- [817] R. Koelliker, H. Thies, Solubility of carbon monoxide in n-hexane between 293 and 473 K and carbon monoxide pressures up to 200 bar, *J. Chem. Eng. Data.* 38 (1993) 437–440, doi:[10.1021/je00011a029](https://doi.org/10.1021/je00011a029).
- [818] J.F. Connolly, G.A. Kandalic, Thermodynamic properties of dilute solutions of carbon monoxide in a hydrocarbon, *J. Chem. Thermodyn.* 16 (1984) 1129–1139, doi:[10.1016/0021-9614\(84\)90184-8](https://doi.org/10.1016/0021-9614(84)90184-8).
- [819] S. Srivatsan, X. Yi, R.L.Jr. Robinson, K.A.M. Gasem, Solubilities of carbon monoxide in heavy normal paraffins at temperatures from 311 to 423 K and pressures to 10.2 MPa, *J. Chem. Eng. Data.* 40 (1995) 237–240, doi:[10.1021/je00017a050](https://doi.org/10.1021/je00017a050).
- [820] M. Lambert, M. Simon, Excess thermodynamic properties of the liquid systems A-CH<sub>4</sub> and CO-CH<sub>4</sub>, *Physica* 28 (1962) 1191–1196, doi:[10.1016/0031-8914\(62\)90066-6](https://doi.org/10.1016/0031-8914(62)90066-6).
- [821] R.a.H. Pool, L.a.K. Staveley, A calorimeter for measuring the heat of mixing of liquefied gases. The heat and excess entropy of mixing of liquid methane and carbon monoxide, *Trans. Faraday Soc.* 53 (1957) 1186–1197, doi:[10.1039/TF9575301186](https://doi.org/10.1039/TF9575301186).
- [822] A. Toyama, P.S. Chappellear, T.W. Leland, R. Kobayashi, Vapor-liquid equilibria at low temperatures: the carbon monoxide-methane system, *Adv. Cryog. Eng.* (1962) 125–136, doi:[10.1007/978-1-4757-0531-7\\_15](https://doi.org/10.1007/978-1-4757-0531-7_15).
- [823] V. Mathot, L.a.K. Staveley, J.A. Young, N.G. Parsonage, Thermodynamic properties of the system methane + carbon monoxide at 90–67° K, *Trans. Faraday Soc.* 52 (1956) 1488–1500, doi:[10.1039/TF9565201488](https://doi.org/10.1039/TF9565201488).
- [824] L.J. Christiansen, Aa. Fredenslund, J. Mollerup, Vapor-liquid equilibrium of the CH<sub>4</sub>-Ar, CH<sub>4</sub>-CO, and Ar-CO systems at elevated pressures, *Cryogenics* 13 (1973) 405–413, doi:[10.1016/0011-2275\(73\)90076-3](https://doi.org/10.1016/0011-2275(73)90076-3).
- [825] J. Park, X. Yi, K.A.M. Gasem, R.L.Jr. Robinson, Solubilities of carbon monoxide in aromatic hydrocarbons at temperatures from 323 to 433 K and pressures to 23.3 MPa, *J. Chem. Eng. Data.* 40 (1995) 245–247, doi:[10.1021/je00017a052](https://doi.org/10.1021/je00017a052).
- [826] P.J. McElroy, J. Moser, Excess and unlike-Interaction second virial coefficients and excess molar enthalpy of (0.500CO + 0.500CO<sub>2</sub>), *J. Chem. Thermodyn.* 27 (1995) 267–271, doi:[10.1006/jcht.1995.0025](https://doi.org/10.1006/jcht.1995.0025).
- [827] L.J. Christiansen, A. Fredenslund, N. Gardner, Gas-liquid equilibria carbon dioxide-carbon monoxide and carbon dioxide-methane-carbon monoxide systems. [Applicable to coal gasification processes], *Adv Cryog Eng U. S.* 19 (1974) <https://www.osti.gov/biblio/5081472>. (accessed October 13, 2019).
- [828] S. Huamin, Hua Xue Gong Cheng 19 (1991) 61–69.
- [829] P.J. McElroy, S. Buchanan, Second virial coefficients of fuel-gas components: (carbon monoxide + nitrogen) and (carbon monoxide + ethene), *J. Chem. Thermodyn.* 27 (1995) 755–761, doi:[10.1006/jcht.1995.0078](https://doi.org/10.1006/jcht.1995.0078).
- [830] P. Gopal, W.G. Chapman, J.A. Zollweg, P. Clancy, W.B. Streett, Excess enthalpies of {xN<sub>2</sub> + (1 - x)CO}(l) at 83.82 K: experiment and theory, *J. Chem. Thermodyn.* 19 (1987) 527–534, doi:[10.1016/S0021-9614\(87\)80001-0](https://doi.org/10.1016/S0021-9614(87)80001-0).
- [831] F. Steckel, Dew- and boiling-point curves of nitrogen-carbon monoxide mixtures up to 17atm, *Phys Z Sowjetunion* 8 (1935) 337–341.
- [832] A.G. Duncan, L.a.K. Staveley, Thermodynamic functions for the liquid systems argon + carbon monoxide, oxygen + nitrogen, and carbon monoxide + nitrogen, *Trans. Faraday Soc.* 62 (1966) 548–552, doi:[10.1039/TF9666200548](https://doi.org/10.1039/TF9666200548).
- [833] R.a.H. Pool, G. Saville, T.M. Herrington, B.D.C. Shields, L.a.K. Staveley, Some excess thermodynamic functions for the liquid systems argon + oxygen, argon + nitrogen, nitrogen + oxygen, nitrogen + carbon monoxide, and argon + carbon monoxide, *Trans. Faraday Soc.* 58 (1962) 1692–1704, doi:[10.1039/TF9625801692](https://doi.org/10.1039/TF9625801692).
- [834] P. Arpentiner, C. Coquelet, Private communication on not yet published data (2014).
- [835] E. El Ahmar, A. Valtz, N. Ferrando, C. Coquelet, P. Mougou, Vapor-Liquid Equilibrium (PTxy) Measurements and Modeling for the CO-C<sub>2</sub>H<sub>4</sub> Binary System, *J. Chem. Eng. Data.* 57 (2012) 2744–2749, doi:[10.1021/je300599p](https://doi.org/10.1021/je300599p).
- [836] C.Y. Tsang, W.B. Streett, Phase equilibria in the H<sub>2</sub> CO system at temperatures from 70 to 125 K and pressures to 53 MPa, *Fluid Phase Equilibria* 6 (1981) 261–273, doi:[10.1016/0378-3812\(81\)85008-X](https://doi.org/10.1016/0378-3812(81)85008-X).
- [837] E.J.S.G. Azevedo, L.Q. Lobo, L.A.K. Staveley, P. Clancy, Thermodynamics of liquid mixtures of argon + carbon monoxide, *Fluid Phase Equilibria* 9 (1982) 267–277, doi:[10.1016/0378-3812\(82\)80022-8](https://doi.org/10.1016/0378-3812(82)80022-8).
- [838] R.A. Aronovich, I.I. Vasil'eva, S.M. Lokteva, A.A. Naumova, A.A. Polyakov, E.V. Slivinskii, T.N. Tyvina, V.V. Fokina, *Huaxue Fanying Gongcheng Yu Gongyi* 16 (2000) 396–400.
- [839] A. Fredenslund, J. Mollerup, Gas-liquid equilibrium of hydrogen sulphide + carbon monoxide, *J. Chem. Thermodyn.* 7 (1975) 677–682, doi:[10.1016/0021-9614\(75\)90008-7](https://doi.org/10.1016/0021-9614(75)90008-7).
- [840] H.M. Lin, R.J. Lee, M.J. Lee, High-temperature vapor-liquid equilibria of helium + 1-methylnaphthalene and helium + n-hexadecane, *Fluid Phase Equilibria* 111 (1995) 89–99, doi:[10.1016/0378-3812\(95\)02768-A](https://doi.org/10.1016/0378-3812(95)02768-A).
- [841] I. Nikitina, V. Skripka, G. Gubkina, Solubility of helium in iso-andn-butane at low temperatures and pressures, *Gazov Promyshlennost* 14 (1969) 35–37.
- [842] J.E. Sinor, D.L. Schindler, F. Kurata, Vapor-liquid phase behavior of the

- helium-methane system, *AIChE J.* 12 (1966) 353–357, doi:10.1002/aic.690120227.
- [843] P.C. Tully, W.E. DeVaney, H.L. Rhodes, Phase equilibrium data for helium-methane system, *J. Chem. Eng. Data.* 16 (1971) 158–161, doi:10.1021/jc60049a011.
- [844] C.K. Heck, M.J. Hiza, Liquid-vapor equilibrium in the system helium-methane, *AIChE J.* 13 (1967) 593–599, doi:10.1002/aic.690130335.
- [845] M. Gonikberg, V. Fastovskii, Solubility of gases in liquids at low temperatures and high pressures. IV. Solubility of helium in liquid methane at 90.3 and 106.0 K and at pressures up to 160 atm, *Acta Physicochim URSS* 13 (1940) 399–404.
- [846] F. Kharakhori, Liquid-vapor equilibrium in a helium-methane system, *Inzhenerno-Fiz Zh* 2 (1959) 55–59.
- [847] W. Street, A. Erickson, J. Hill, Phase equilibria in fluid mixtures at high pressures: the He-CH<sub>4</sub> system, *Phys. Earth Planet. Inter.* 6 (1972) 69–77.
- [848] C.M. Bignell, P.J. Dunlop, Second virial coefficients for seven fluoroethanes and interaction second virial coefficients for their binary mixtures with helium and argon, *J. Chem. Phys.* 98 (1993) 4889–4891, doi:10.1063/1.464943.
- [849] C. Heck, *Experimental and Theoretical Liquid-Vapor Equilibria in Some Binary Systems* (Thesis) (1968).
- [850] I. Nikitina, V. Skripka, G. Gubkina, A.G. Sirotn, O.A. Ben-yaminovich, Solubility of helium in liquid ethane at low temperatures and pressures to 120 kg/cm<sup>2</sup>, *Gazov Promyshlennost* 15 (1970) 35–37.
- [851] D.W. Burfield, H.P. Richardson, R.A. Guereca, Vapor-liquid equilibria and dielectric constants for the helium-carbon dioxide system, *AIChE J.* 16 (1970) 97–100, doi:10.1002/aic.690160119.
- [852] R.F. Mackendrick, C.K. Heck, P.L. Barrick, Liquid-vapor equilibria of the helium-carbon dioxide system, *J. Chem. Eng. Data.* 13 (1968) 352–353, doi:10.1021/jc60038a014.
- [853] F. Liu, *Phase Equilibria in the Helium-Carbon Dioxide, -Argon, -Methane, -Nitrogen, and -Oxygen Systems* (Thesis) (1969).
- [854] N. Kuskova, V. Martynets, E. Matizen, Experimental pressure-density-temperature-composition dependences of dilute binary solutions of helium in carbon dioxide near the critical vaporization line, *Teplofiz Svoistv Veshchestv Mater Mosk* 27 (1989) 82–95.
- [855] I.A. Davydov, S.S. Budnevich, Investigation of the equilibrium composition of a nitrogen-helium mixture, *J. Eng. Phys.* 20 (1971) 776–779, doi:10.1007/BF01122605.
- [856] W. Street, Gas-liquid and fluid-fluid phase separation in the system helium-nitrogen near the critical temperature of nitrogen, *Chem. Eng. Prog. Symp. Ser.* 63 (1967) 37–42.
- [857] M. Gonikberg, V. Fastovskii, The solubility of gases in liquids at low temperatures and high pressure, *Zh. Fiz. Khim.* 14 (1940) 1128–1131.
- [858] R.J. Burch, Low temperature phase equilibria of the gas-liquid system helium-neon-nitrogen, *J. Chem. Eng. Data.* 9 (1964) 19–24, doi:10.1021/jc60020a008.
- [859] J.A. Davis, N. Rodewald, F. Kurata, An apparatus for phase studies between 20° K and 300° K, *Ind. Eng. Chem.* 55 (1963) 36–42, doi:10.1021/ie50647a007.
- [860] B. Dalton, Vapor-Liquid Equilibria of the Helium-Nitrogen System, *J. Chem. Eng. Data.* 8 (1963) 473–478, doi:10.1021/jc60019a001.
- [861] M. Gonikberg, V. Fastovskii, Solubility of gases in liquids at low temperatures and high pressures. II. Solubility of helium in liquid nitrogen at temperatures from 78.0 to 109.0 K and at pressures up to 295 atm, *Acta Physicochim URSS* 12 (1940) 67–72.
- [862] W.B. Streett, J.L.E. Hill, Phase Equilibria in Fluid Mixtures at High Pressures: The Helium-Nitrogen System, *J. Chem. Phys.* 52 (1970) 1402–1406, doi:10.1063/1.1673144.
- [863] F. Kharakhori, Phase relations in systems of liquefied gases, *Zh Tekhn Fiz* 10 (1940) 1533–1540.
- [864] N.C. Rodewald, J.A. Davis, F. Kurata, The heterogeneous phase behavior of the helium-nitrogen system, *AIChE J.* 10 (1964) 937–943, doi:10.1002/aic.690100631.
- [865] W.B. Streett, A.L. Erickson, Phase equilibria in gas mixtures at high pressures: Implications for planetary structures, *Phys. Earth Planet. Inter.* 5 (1972) 357–366, doi:10.1016/0031-9201(72)90107-0.
- [866] P.C. Tully, W.E. DeVaney, H.L. Rhodes, Phase Equilibria of the Helium-Nitrogen System from 122 to 126°K, *Adv. Cryog. Eng.* (1971) 88–95, doi:10.1007/978-1-4757-0244-6\_11.
- [867] V. Skripka, N. Dykhno, Solubility of helium and neon in liquid oxygen, nitrogen, and argon from 67 to 901 K and 6 to 26 atm, *Tr Vses Nauchn-Issled Inst Kislorodn Mashinost* 8 (1964) 163–179.
- [868] L.C. Van Den Bergh, J.A. Schouten, The critical line and the three-phase line in a molecular helium-nitrogen mixture up to 100 kbar, *Chem. Phys. Lett.* 145 (1988) 471–474, doi:10.1016/0009-2614(88)80211-2.
- [869] J.D. Garber, W.T. Ziegler, Gas-liquid equilibrium for the helium-ethylene and helium-propylene systems below 260 K and 120 atm, *J. Chem. Eng. Data.* 24 (1979) 330–338, doi:10.1021/jc60083a016.
- [870] M.J. Hiza, A.G. Duncan, Equilibrium Gas-Phase Compositions of Ethane and Ethylene in Binary Mixtures with Helium and Neon below 150°K and a Correlation for Deviations from the Geometric Mean Combining Rule, in: K.D. Timmerhaus (Ed.), *Adv. Cryog. Eng.*, Springer US, 1969, pp. 30–40.
- [871] R.E. Sonntag, G.J. Van Wylene, R.W. Crain, Liquid-Vapor Equilibrium in the System Equilibrium Hydrogen-Helium, *J. Chem. Phys.* 41 (1964) 2399–2402, doi:10.1063/1.1726277.
- [872] W.B. Streett, R.E. Sonntag, G.J. Van Wylene, Liquid-Vapor Equilibrium in the System Normal Hydrogen-Helium, *J. Chem. Phys.* 40 (1964) 1390–1395, doi:10.1063/1.1725322.
- [873] C.M. Sneed, R.E. Sonntag, G.J. Van Wylene, Helium-Hydrogen Liquid-Vapor Equilibrium to 100 atm, *J. Chem. Phys.* 49 (1968) 2410–2414, doi:10.1063/1.1670414.
- [874] W. Streett, *Phase equilibria in molecular hydrogen-helium mixtures at high pressures*, *Astrophys. J.* 186 (1973) 1107–1125.
- [875] M.J. Hiza, Liquid-vapor equilibria in binary systems containing 4He or 3He with nH<sub>2</sub> or nD<sub>2</sub>, *Fluid Phase Equilibria* 6 (1981) 203–227, doi:10.1016/0378-3812(81)85005-4.
- [876] T. Yamanishi, K. Okuno, Y. Naruse, E. Sada, Liquid-vapor equilibrium in binary systems for He in n-hydrogen, hydrogen deuteride, and n-deuterium under ordinary pressure, *J. Phys. Chem.* 96 (1992) 2284–2289, doi:10.1021/j100184a048.
- [877] V. Pashkov, Y. Blagoi, M. Lobko, Liquid-vapor phase equilibrium in helium-parahydrogen solutions, *Fiz Nizk Temp* 7 (1981) 549–559.
- [878] S. Smith, *Gas-Liquid Phase Equilibrium in the System He-H<sub>2</sub>. II. Development of Mass Spectrograph Techniques for analysis of He-H<sub>2</sub> and Their Isotopes*, Thesis (1952).
- [879] W.R. Parrish, W.G. Steward, Vapor-liquid equilibria data for helium-carbon monoxide and helium-nitrous oxide systems, *J. Chem. Eng. Data.* 20 (1975) 412–416, doi:10.1021/jc60067a012.
- [880] J.E. Sinor, F. Kurata, Solubility of Helium in Liquid Argon, Oxygen, and Carbon Monoxide, *J. Chem. Eng. Data.* 11 (1966) 537–539, doi:10.1021/jc60031a019.
- [881] B. Sisskind, I. Kasarnowsky, Untersuchungen über die Löslichkeit der Gase. I. Mitteilung. Löslichkeit des Argons unter hohen Drucken, *Z. Für Anorg. Allg. Chem.* 200 (1931) 279–286, doi:10.1002/zaac.19312000124.
- [882] G. Wu, M. Heilig, H. Lentz, E.U. Franck, High Pressure Phase Equilibria of the Water-Argon System, *Berichte Bunsenges. Für Phys. Chem.* 94 (1990) 24–27, doi:10.1002/bbpc.19900940106.
- [883] P. Richards, C.J. Wormald, The Enthalpy of Mixing of (Water + Argon) Vapour, *Z. Für Phys. Chem.* 128 (1981) 35–42, doi:10.1524/zpch.1981.128.1.035.
- [884] C. Wormald, C. Colling, Excess enthalpy experimental data binary systems: water + hydrogen, water + methane, water + nitrogen, water + argon, *GPA Tech Publ* 7 (1982) 1–52.
- [885] C.J. Wormald, C.N. Colling, Excess enthalpies of (water+argon)(g) at temperatures up to 698.2 K and pressures up to 13.3 MPa, *J. Chem. Thermodyn.* 25 (1993) 599–605, doi:10.1006/jcht.1993.1054.
- [886] H. Lentz, E. Franck, Das System Wasser-Argon bei hohen Drucken und Temperaturen, *Berichte Bunsenges. Für Phys. Chem.* 73 (1969) 28–35.
- [887] W.B. Streett, Gas-liquid and fluid-fluid phase separation in the system helium+argon at high pressures, *Trans. Faraday Soc.* 65 (1969) 696–702, doi:10.1039/TF9696500696.
- [888] W.B. Streett, J.L.E. Hill, Phase equilibria in fluid mixtures at high pressures: the helium+argon system, *Trans. Faraday Soc.* 67 (1971) 622–630, doi:10.1039/TF9716700622.
- [889] V. Skripka, N. Lobanova, Phase and volume ratios at low temperatures and high pressures. I. Solubility of helium and neon in liquid oxygen, nitrogen, and argon, *Tr Vses Nauch-Issled Inst Kriog Mashinost* 13 (1971) 90–103.
- [890] J. Mullins, W. Ziegler, Phase equilibria in the argon-helium and argon-hydrogen systems from 68 to 108 K and pressures to 120 atm, *Adv. Cryog. Eng.* 10 (1965) 171–181.
- [891] E. Naumowicz, K. Olesiak, W. Wóycicki, Excess enthalpy of (argon + helium), *J. Chem. Thermodyn.* 13 (1981) 899–900, doi:10.1016/0021-9614(81)90103-8.
- [892] N. Yarym-Agaev, V. Matvienko, Y. Grozner, Argon solubility in benzene and hexane at elevated pressures, *Russ. J. Appl. Chem.* 68 (1995) 168–171.
- [893] Z.N. Baranovich, L.P. Bogdanova, A.M. Smirnova, *J Appl Chem USSR* 42 (1969) 1310–1313.
- [894] S.E. Mosedale, C.J. Wormald, The enthalpy of mixing of argon + methane at 123, 130, 140, and 145 K, at pressures up to 9.12 MPa, *J. Chem. Thermodyn.* 9 (1977) 483–490, doi:10.1016/0021-9614(77)90149-5.
- [895] A.J. Kidnay, K.L. Lewis, J.C.G. Calado, L.A.K. Staveley, The thermodynamics of liquid mixtures of argon + methane, *J. Chem. Thermodyn.* 7 (1975) 847–854, doi:10.1016/0021-9614(75)90093-2.
- [896] K.L. Lewis, G. Saville, L.A.K. Staveley, Excess enthalpies of liquid oxygen + argon, oxygen + nitrogen, and argon + methane, *J. Chem. Thermodyn.* 7 (1975) 389–400, doi:10.1016/0021-9614(75)90178-0.
- [897] S.F. Barreiros, M. Nunes Da Ponte, J.C.G. Calado, Excess thermodynamic properties of argon + methane: a standard simple liquid system, *Fluid Phase Equilibria* 49 (1989) 9–20, doi:10.1016/0378-3812(89)80002-0.
- [898] J.C.G. Calado, L.A.K. Staveley, Excess gibbs energy of argon-methane liquid mixtures at 115.77°K, *J. Chem. Phys.* 56 (1972) 4718–4719, doi:10.1063/1.1677927.
- [899] L.J. Christiansen, Aa. Fredenslund, Vapour-liquid equilibria of the CH<sub>4</sub>-Ar-CO system, *Cryogenics* 14 (1974) 10–14, doi:10.1016/0011-2275(74)90037-X.
- [900] L.V. Shatskaya, N.A. Zhirnova, Liquid-vapor phase equilibria in two-component systems at low temperatures. I. Argon-methane system, *Russ. J. Phys. Chem.* 50 (1976) 298.
- [901] Y. Wang, B. Han, H. Yan, R. Liu, Solubility of CH<sub>4</sub> in the mixed solvent t-butyl alcohol and water, *Thermochim. Acta.* 253 (1995) 327–334, doi:10.1016/0040-6031(94)02011-C.
- [902] J.J. Carroll, F.-Y. Jou, A.E. Mather, F.D. Otto, The solubility of methane in aque-

- ous solutions of monoethanolamine, diethanolamine and triethanolamine, *Can. J. Chem. Eng.* 76 (1998) 945–951, doi:10.1002/cjce.5450760512.
- [903] S.O. Yang, S.H. Cho, H. Lee, C.S. Lee, Measurement and prediction of phase equilibria for water + methane in hydrate forming conditions, *Fluid Phase Equilibria* 185 (2001) 53–63, doi:10.1016/S0378-3812(01)00456-3.
- [904] A. Chapoy, C. Coquelet, D. Richon, Solubility measurement and modeling of water in the gas phase of the methane/water binary system at temperatures from 283.08 to 318.12K and pressures up to 34.5MPa, *Fluid Phase Equilibria* 214 (2003) 101–117, doi:10.1016/S0378-3812(03)00322-4.
- [905] J. Kiepe, S. Horstmann, K. Fischer, J. Gmehling, Experimental Determination and Prediction of Gas Solubility Data for Methane + Water Solutions Containing Different Monovalent Electrolytes, *Ind. Eng. Chem. Res.* 42 (2003) 5392–5398, doi:10.1021/ie030386x.
- [906] A. Chapoy, A.H. Mohammadi, D. Richon, B. Tohidi, Gas solubility measurement and modeling for methane–water and methane–ethane–n-butane–water systems at low temperature conditions, *Fluid Phase Equilibria* 220 (2004) 113–121, doi:10.1016/j.fluid.2004.02.010.
- [907] J. Addicks, G.A. Owren, A.O. Fredheim, K. Tangvik, Solubility of Carbon Dioxide and Methane in Aqueous Methyl-diethanolamine Solutions, *J. Chem. Eng. Data.* 47 (2002) 855–860, doi:10.1021/je010292z.
- [908] Y.S. Kim, S.K. Ryu, S.O. Yang, C.S. Lee, Liquid water-hydrate equilibrium measurements and unified predictions of hydrate-containing phase equilibria for methane, ethane, propane, and their mixtures, *Ind. Eng. Chem. Res.* 42 (2003) 2409–2414, doi:10.1021/ie0209374.
- [909] L.-K. Wang, G.-J. Chen, G.-H. Han, X.-Q. Guo, T.-M. Guo, Experimental study on the solubility of natural gas components in water with or without hydrate inhibitor, *Fluid Phase Equilibria* 207 (2003) 143–154, doi:10.1016/S0378-3812(03)00009-8.
- [910] R. Crovetto, R. Fernández-Prini, M.L. Japas, Solubilities of inert gases and methane in H<sub>2</sub>O and in D<sub>2</sub>O in the temperature range of 300 to 600 K, *J. Chem. Phys.* 76 (1982) 1077–1086, doi:10.1063/1.443074.
- [911] A. Fenghour, W.A. Wakeham, J.T.R. Watson, Densities of (water + methane) in the temperature range 430 K to 699 K and at pressures up to 30 MPa, *J. Chem. Thermodyn.* 28 (1996) 447–458, doi:10.1006/jcht.1996.0044.
- [912] A.H. Mohammadi, A. Chapoy, D. Richon, B. Tohidi, Experimental Measurement and Thermodynamic Modeling of Water Content in Methane and Ethane Systems, *Ind. Eng. Chem. Res.* 43 (2004) 7148–7162, doi:10.1021/ie049843f.
- [913] A. Chapoy, A.H. Mohammadi, B. Tohidi, D. Richon, Estimation of water content for methane + water and methane + ethane + n-butane + water systems using a new sampling device, *J. Chem. Eng. Data.* 50 (2005) 1157–1161, doi:10.1021/je049615s.
- [914] P. Servio, P. Englezos, Measurement of Dissolved Methane in Water in Equilibrium with Its Hydrate, *J. Chem. Eng. Data.* 47 (2002) 87–90, doi:10.1021/je0102255.
- [915] V.M. Shmonov, R.J. Sadus, E.U. Franck, High-pressure phase equilibria and supercritical pVT data of the binary water + methane mixture to 723 K and 200 MPa, *J. Phys. Chem.* 97 (1993) 9054–9059, doi:10.1021/j100137a036.
- [916] R.G. Anthony, J.J. McKetta, Phase equilibrium in the ethylene-water system, *J. Chem. Eng. Data.* 12 (1967) 17–20, doi:10.1021/je60032a006.
- [917] A.D. King, C.R. Coan, Solubility of water in compressed carbon dioxide, nitrous oxide, and ethane. Evidence for hydration of carbon dioxide and nitrous oxide in the gas phase, *J. Am. Chem. Soc.* 93 (1971) 1857–1862, doi:10.1021/ja00737a004.
- [918] O.L. Culberson, J.J.J. McKetta, Phase Equilibria in Hydrocarbon-Water Systems II - The Solubility of Ethane in Water at Pressures to 10,000 psi, *J. Pet. Technol.* 2 (1950) 319–322, doi:10.2118/950319-G.
- [919] A. Dhima, J.-C. de Hemptinne, G. Moracchini, Solubility of light hydrocarbons and their mixtures in pure water under high pressure, *Fluid Phase Equilibria* 145 (1998) 129–150, doi:10.1016/S0378-3812(97)00211-2.
- [920] O.L. Culberson, J.J.J. McKetta, Phase Equilibria In Hydrocarbon-Water Systems IV - Vapor-Liquid Equilibrium Constants in the Methane-Water and Ethane-Water Systems, *J. Pet. Technol.* 3 (1951) 297–300, doi:10.2118/951297-G.
- [921] H.H. Reamer, R.H. Olds, B.H. Sage, W.N. Lacey, Phase equilibria in hydrocarbon systems. composition of dew-point gas in ethane-water system, *Ind. Eng. Chem.* 35 (1943) 790–793, doi:10.1021/ie50403a012.
- [922] A. Chapoy, C. Coquelet, D. Richon, Measurement of the water solubility in the gas phase of the ethane + water binary system near hydrate forming conditions, *J. Chem. Eng. Data.* 48 (2003) 957–966, doi:10.1021/je0202230.
- [923] A.H. Mohammadi, A. Chapoy, B. Tohidi, D. Richon, Measurements and thermodynamic modeling of vapor-liquid equilibria in ethane-water systems from 274.26 to 343.08 K, *Ind. Eng. Chem. Res.* 43 (2004) 5418–5424, doi:10.1021/ie049747e.
- [924] K. Sparks, E. Sloan, *Water Content of NGL in the Presence of Hydrates*, GPA Research Report RR-71 (1983) 1–26 (n.d.).
- [925] A. Niini, Determination of the pressure isotherm for water, methanol and ethanol mixtures and an estimation of the van der Waals forces in liquids. I. non-polar solvents, *Ann Acad Sci Fenn. Ser. A.* 55 (1940) 1–52.
- [926] M.S.H. Bader, K.A.M. Gasem, Determination of infinite dilution activity coefficients for organic-aqueous systems using a dilute vapor-liquid equilibrium method, *Chem. Eng. Commun.* 140 (1995) 41–72, doi:10.1080/00986449608936454.
- [927] A. Valtz, M. Hegarty, D. Richon, Experimental determination of the solubility of aromatic compounds in aqueous solutions of various amines, *Fluid Phase Equilibria* 210 (2003) 257–276, doi:10.1016/S0378-3812(03)00173-0.
- [928] A. Valtz, P. Guilbot, D. Richon, *Amine BTEX Solubility (2002)*.
- [929] Y. Chmara, Possible interpretation of azeotropism as properties of vapor-liquid systems with chemical reactions, *Zh. Fiz. Khim.* 56 (1982) 1065–1078.
- [930] F.E. Anderson, J.M. Prausnitz, Mutual solubilities and vapor pressures for binary and ternary aqueous systems containing benzene, toluene, m-xylene, thiophene and pyridine in the region 100–200°C, *Fluid Phase Equilibria* 32 (1986) 63–76, doi:10.1016/0378-3812(86)87006-6.
- [931] C. Tsonopoulos, G.M. Wilson, High-temperature mutual solubilities of hydrocarbons and water. Part I: Benzene, cyclohexane and n-hexane, *AIChE J* 29 (1983) 990–999, doi:10.1002/aic.690290618.
- [932] C.J. Rebert, W.B. Kay, The phase behavior and solubility relations of the benzene-water system, *AIChE J* 5 (1959) 285–289, doi:10.1002/aic.69005307.
- [933] M.G. Rabezkii, A.R. Bazaev, I.M. Abdulgatov, J.W. Magee, E.A. Bazaev, PVTx Measurements for Water + Toluene Mixtures in the Near-Critical and Supercritical Regions, *J. Chem. Eng. Data.* 46 (2001) 1610–1618, doi:10.1021/je010176w.
- [934] M. Wobst, K. Moerke, Determination of the vapor-liquid equilibria in binary systems formed by maleic anhydride, maleic acid, o-xylene, and water, *FIZ Rep.* (1990) 5311.
- [935] J.L. Heidman, C. Tsonopoulos, C.J. Brady, G.M. Wilson, High-temperature mutual solubilities of hydrocarbons and water. Part II: Ethylbenzene, ethylcyclohexane, and n-octane, *AIChE J* 31 (1985) 376–384, doi:10.1002/aic.690310304.
- [936] S.P. Christensen, M.E. Paulaitis, Phase equilibria for tetralin-water and 1-methylnaphthalene-water mixtures at elevated temperatures and pressures, *Fluid Phase Equilibria* 71 (1992) 63–83, doi:10.1016/0378-3812(92)85005-S.
- [937] R. Inga, J. McKetta, Solubility of Cyclopropane in Water, *Pet Refin* 40 (1961) 191–193.
- [938] K. Broellos, K. Peter, G. Schneider, Fluid mixed systems under high pressure. Phase equilibria and critical points in the binary systems cyclohexane-water, n-heptane-water, biphenyl-water, and benzene-water-d<sub>2</sub> at 420 deg. and 3000 bar, *Ber. Bunsen-Ges. Phys. Chem.* 74 (1970) 682–686.
- [939] R. Vilcu, I. Gainer, Solubility of gases in liquids under pressure. I. the system carbon dioxide - water, *Rev. Roum. Chim.* 12 (1967) 181–189.
- [940] S. Takenouchi, G.C. Kennedy, The binary system H<sub>2</sub> O-CO<sub>2</sub> at high temperatures and pressures, *Am. J. Sci.* 262 (1964) 1055–1074, doi:10.2475/ajs.262.9.1055.
- [941] K. Tödheide, E.U. Franck, Das Zweiphasengebiet und die kritische Kurve im System Kohlendioxid-Wasser bis zu Drucken von 3500 bar, *Z. Für Phys. Chem.* 37 (1963) 387–401, doi:10.1524/zpch.1963.37.5.6.387.
- [942] S. Zaalishvili, Solubility of carbon dioxide from its mixtures with hydrogen and nitrogen in water under pressure, *Zh. Fiz. Khim.* 14 (1940) 413–417.
- [943] R. Wiebe, V.L. Gaddy, The solubility of carbon dioxide in water at various temperatures from 12 to 40° and at pressures to 500 atmospheres. critical phenomena\*, *J. Am. Chem. Soc.* 62 (1940) 815–817, doi:10.1021/ja01861a033.
- [944] R. Crovetto, R.H. Wood, Solubility of CO<sub>2</sub> in water and density of aqueous CO<sub>2</sub> near the solvent critical temperature, *Fluid Phase Equilibria* 74 (1992) 271–288, doi:10.1016/0378-3812(92)85067-1.
- [945] H. Teng, A. Yamasaki, M.-K. Chun, H. Lee, Solubility of liquid CO<sub>2</sub> in water at temperatures from 278 K to 293 K and pressures from 6.44 MPa to 29.49 MPa and densities of the corresponding aqueous solutions, *J. Chem. Thermodyn.* 29 (1997) 1301–1310, doi:10.1006/jcht.1997.0249.
- [946] K. Fischer, M. Petri, J. Chen, unpublished data (1995) (n.d.).
- [947] J.A. Briones, J.C. Mullins, M.C. Thies, B.-U. Kim, Ternary phase equilibria for acetic acid-water mixtures with supercritical carbon dioxide, *Fluid Phase Equilibria* 36 (1987) 235–246, doi:10.1016/0378-3812(87)85026-4.
- [948] T. Nakayama, H. Sagara, K. Arai, S. Saito, High pressure liquid-liquid equilibria for the system of water, ethanol and 1,1-difluoroethane at 323.2 K, *Fluid Phase Equilibria* 38 (1987) 109–127, doi:10.1016/0378-3812(87)90007-0.
- [949] G. Mueller, Experimental study of the vapor-liquid equilibrium in the system ammonia-carbon dioxide-water from 100 to 200 C at pressure up to 90 bar, Thesis. University of Kaiserslautern (1983) 1–174 (n.d.).
- [950] S. Malinin, The system H<sub>2</sub>O-CO<sub>2</sub> at high temperatures and pressures, *Geokhimiya* 3 (1959) 235–245.
- [951] A. Bamberger, G. Sieder, G. Maurer, High-pressure (vapor+liquid) equilibrium in binary mixtures of (carbon dioxide+water or acetic acid) at temperatures from 313 to 353 K, *J. Supercrit. Fluids.* 17 (2000) 97–110, doi:10.1016/S0896-8446(99)00054-6.
- [952] A. Zawisza, B. Malesinska, Solubility of carbon dioxide in liquid water and of water in gaseous carbon dioxide in the range 0.2–5 MPa and at temperatures up to 473 K, *J. Chem. Eng. Data.* 26 (1981) 388–391, doi:10.1021/je00026a012.
- [953] R. Dohrn, A.P. Bünz, F. Devlieghere, D. Thelen, Experimental measurements of phase equilibria for ternary and quaternary systems of glucose, water, CO<sub>2</sub> and ethanol with a novel apparatus, *Fluid Phase Equilibria* 83 (1993) 149–158, doi:10.1016/0378-3812(93)87017-U.
- [954] G.K. Anderson, Solubility of carbon dioxide in water under incipient clathrate formation conditions, *J. Chem. Eng. Data.* 47 (2002) 219–222, doi:10.1021/je015518c.
- [955] T. Sako, T. Sugeta, N. Nakazawa, T. Okubo, M. Sato, T. Taguchi, T. Hiaki, Phase equilibrium study of extraction and concentration of furfural produced in reactor using supercritical carbon dioxide, *J. Chem. Eng. Jpn.* 24 (1991) 449–455, doi:10.1252/jcej.24.449.
- [956] S. Takenouchi, G.C. Kennedy, The solubility of carbon dioxide in nacl solu-

- tions at high temperatures and pressures, *Am. J. Sci.* 263 (1965) 445–454, doi:10.2475/ajs.263.5.445.
- [57] M.B. King, A. Mubarak, J.D. Kim, T.R. Bott, The mutual solubilities of water with supercritical and liquid carbon dioxides, *J. Supercrit. Fluids.* 5 (1992) 296–302, doi:10.1016/0896-8446(92)90021-B.
- [58] I. Sidorov, Y. Kazarnovskii, A. Goldman, The Solubility of Water in compressed Gases, *Tr Gos Nauchno Issled Proekt Inst Azotn Promst Prod Org Sin 1* (1953) 48–67.
- [59] D.-Q. Zheng, T.-M. Guo, H. Knapp, Experimental and modeling studies on the solubility of CO<sub>2</sub>, CHClF<sub>2</sub>, CHF<sub>3</sub>, C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> and C<sub>2</sub>H<sub>4</sub>F<sub>2</sub> in water and aqueous NaCl solutions under low pressures, *Fluid Phase Equilibria* 129 (1997) 197–209, doi:10.1016/S0378-3812(96)03177-9.
- [60] D. Silkenbäumer, B. Rumpf, R.N. Lichtenthaler, Solubility of Carbon Dioxide in Aqueous Solutions of 2-Amino-2-methyl-1-propanol and N-Methyldiethanolamine and Their Mixtures in the Temperature Range from 313 to 353 K and Pressures up to 2.7 MPa, *Ind. Eng. Chem. Res.* 37 (1998) 3133–3141, doi:10.1021/ie970925w.
- [61] R. Wiebe, V.L. Gaddy, Vapor phase composition of carbon dioxide-water mixtures at various temperatures and at pressures to 700 atmospheres, *J. Am. Chem. Soc.* 63 (1941) 475–477, doi:10.1021/ja01847a030.
- [62] F. Gu, Solubility of carbon dioxide in aqueous sodium chloride solution under high pressure, *Gaoxiao Huaxue Gongcheng Xuebao* 12 (1998) 118–123.
- [63] Z. Cai, Z. Wu, Measurement and correlation of vapor-liquid equilibrium with CO<sub>2</sub> systems at high pressure, *Huaxue Gongcheng* 24 (1996) 71–73.
- [64] Ya.D. Zel'venskii, The solubility of carbon dioxide in water under pressure, *Zh Khim Prom* 14 (1937) 1250–1257.
- [65] C.F. Prutton, R.L. Savage, The solubility of carbon dioxide in calcium chloride-water solutions at 75, 100, 120° and high pressures<sup>1</sup>, *J. Am. Chem. Soc.* 67 (1945) 1550–1554, doi:10.1021/ja01225a047.
- [66] A. Dhima, J.-C. de Hemptinne, J. Jose, Solubility of hydrocarbons and CO<sub>2</sub> mixtures in water under high pressure, *Ind. Eng. Chem. Res.* 38 (1999) 3144–3161, doi:10.1021/ie980768g.
- [67] I. Dalmolin, E. Skovroinski, A. Biasi, M.L. Corazza, C. Dariva, J.V. Oliveira, Solubility of carbon dioxide in binary and ternary mixtures with ethanol and water, *Fluid Phase Equilibria* 245 (2006) 193–200, doi:10.1016/j.fluid.2006.04.017.
- [68] S. Sayegh, J. Najman, CO<sub>2</sub>-SO<sub>2</sub>-Brine Phase Behavior Studies, *Petroleum Recovery Institute, Calgary, Alberta, 1984* (n.d.).
- [69] J. Kiepe, S. Horstmann, K. Fischer, J. Gmehling, Experimental Determination and Prediction of Gas Solubility Data for CO<sub>2</sub> + H<sub>2</sub>O Mixtures Containing NaCl or KCl at Temperatures between 313 and 393 K and Pressures up to 10 MPa, *Ind. Eng. Chem. Res.* 41 (2002) 4393–4398, doi:10.1021/ie020154i.
- [70] Y. Iwai, M. Uno, H. Nagano, Y. Arai, Measurement of solubilities of palmitic acid in supercritical carbon dioxide and entrainer effect of water by FTIR spectroscopy, *J. Supercrit. Fluids.* 28 (2004) 193–200, doi:10.1016/S0896-8446(03)00013-5.
- [71] A. Valtz, A. Chapoy, C. Coquelet, P. Paricaud, D. Richon, Vapor-liquid equilibria in the carbon dioxide-water system, measurement and modelling from 278.2 to 318.2K, *Fluid Phase Equilibria* 226 (2004) 333–344, doi:10.1016/j.fluid.2004.10.013.
- [72] G. Zhang, Y. Wu, P. Ma, The Measurement and Correlation of Carbon Monoxide and Other Gases Solubility in Phenol, in: *Proceedings of The First National Conference on Chemical and Biochemical Engineering*, in: Nanjing, China, 2004, pp. 1–7.
- [73] C.J. Wormald, J.M. Years, Excess molar enthalpies and excess molar volumes of {xCO<sub>2</sub> + (1-x) C<sub>2</sub>H<sub>6</sub>} up to 308.4 K and 11.0 MPa, *J. Chem. Thermodyn.* 20 (1988) 323–331, doi:10.1016/0021-9614(88)90129-2.
- [74] C.J. Wormald, R.W. Hodgetts, Excess enthalpies and volumes for (carbon dioxide + ethane) at T= 291.6 K, close to the minimum in the critical locus, *J. Chem. Thermodyn.* 29 (1997) 75–85, doi:10.1006/jcht.1996.0141.
- [75] C. Pando, J.A.R. Renuncio, R.M. Izatt, J.J. Christensen, The excess molar enthalpies of {xCO<sub>2</sub> + (1-x) C<sub>2</sub>H<sub>6</sub>} from 293.15 to 323.15 K at 7.58 MPa, *J. Chem. Thermodyn.* 15 (1983) 231–235, doi:10.1016/0021-9614(83)90113-1.
- [76] K.P. Wallis, P. Clancy, J.A. Zollweg, W.B. Streett, Excess thermodynamic properties for {xCO<sub>2</sub> + (1-x) C<sub>2</sub>H<sub>6</sub>} (I): experiment and theory, *J. Chem. Thermodyn.* 16 (1984) 811–823, doi:10.1016/0021-9614(84)90028-4.
- [77] J.P. Kuenen, *Z Phys Chem Stoichiometrie Verwandtschaftsftsl* 24 (1897) 667–696.
- [78] C.-H. Kim, P. Vimalchand, M.D. Donohue, Vapor-liquid equilibria for binary mixtures of carbon dioxide with benzene, toluene and p-xylene, *Fluid Phase Equilibria* 31 (1986) 299–311, doi:10.1016/0378-3812(86)87014-5.
- [79] M.K. Gupta, Y.H. Li, B.J. Hulse, R.L. Robinson, Phase equilibrium for carbon dioxide-benzene at 313.2, 353.2, and 393.2 K, *J. Chem. Eng. Data.* 27 (1982) 55–57, doi:10.1021/je00027a017.
- [80] P.G. Bendale, R.M. Enick, Use of carbon dioxide to shift benzene/acetonitrile and benzene/cyclohexane azeotropes, *Fluid Phase Equilibria* 94 (1994) 227–253, doi:10.1016/0378-3812(94)87059-4.
- [81] N. Nagarajan, R.L. Robinson, Equilibrium phase compositions, phase densities, and interfacial tensions for carbon dioxide + hydrocarbon systems. 3. CO<sub>2</sub> + cyclohexane. 4. CO<sub>2</sub> + benzene, *J. Chem. Eng. Data.* 32 (1987) 369–371, doi:10.1021/je00049a025.
- [82] M.W. Barrick, J.M. Anderson, R.L. Robinson, Solubilities of carbon dioxide in cyclohexane and trans-decalin at pressures to 10.7 MPa and temperatures from 323 to 423 K, *J. Chem. Eng. Data.* 31 (1986) 172–175, doi:10.1021/je00044a013.
- [83] W.B. Kay, A. Kreglewski, Critical-locus curves and liquid-vapor equilibria in the binary systems of benzene with carbon dioxide and sulfur dioxide, *Fluid Phase Equilibria* 11 (1983) 251–265, doi:10.1016/0378-3812(83)85028-6.
- [84] C.J. Wormald, R.W. Hodgetts, G.R. Smith, Excess enthalpies of (carbon dioxide + cyclohexane)(g) and of (carbon dioxide + benzene)(g) at the pressure 101.3 kPa over the temperature range 354 K to 399 K, *J. Chem. Thermodyn.* 24 (1992) 943–952, doi:10.1016/S0021-9614(05)80005-9.
- [85] H. Inomata, K. Arai, S. Saito, Vapor-liquid equilibria for CO<sub>2</sub>/hydrocarbon mixtures at elevated temperatures and pressures, *Fluid Phase Equilibria* 36 (1987) 107–119, doi:10.1016/0378-3812(87)85017-3.
- [86] H.M. Sebastian, J.J. Simnick, H.-M. Lin, K.-C. Chao, Gas-liquid equilibrium in mixtures of carbon dioxide + toluene and carbon dioxide + m-xylene, *J. Chem. Eng. Data.* 25 (1980) 246–248, doi:10.1021/je60086a018.
- [87] W.O. Morris, M.D. Donohue, Vapor-liquid equilibria in mixtures containing carbon dioxide, toluene, and 1-methylnaphthalene, *J. Chem. Eng. Data.* 30 (1985) 259–263, doi:10.1021/je00041a007.
- [88] J.H. Hong, R. Kobayashi, Multicomponent vapor-liquid equilibria measurements for the development of an extractive distillation process for the processing of gas issuing from a carbon dioxide/EOR project, *Ind. Eng. Chem. Process Des. Dev.* 25 (1986) 584–589, doi:10.1021/i200033a041.
- [89] D. Walther, B. Platzer, G. Maurer, High-pressure (vapour + liquid) equilibria of (carbon dioxide + methylbenzene or 1,2-dimethylbenzene or 1,3-dimethylbenzene or 1,4-dimethylbenzene) at temperatures between 313 K and 393 K and pressures up to 17.3 MPa, *J. Chem. Thermodyn.* 24 (1992) 387–399, doi:10.1016/S0021-9614(05)80157-0.
- [90] S.D. Fink, H.C. Hershey, Modeling the vapor-liquid equilibria of 1,1,1-trichloroethane + carbon dioxide and toluene + carbon dioxide at 308, 323, and 353 K, *Ind. Eng. Chem. Res.* 29 (1990) 295–306, doi:10.1021/ie00098a022.
- [91] U. Wäterling, D. Zheng, H. Knapp, Vapor-liquid equilibria at high temperatures and pressures in binary mixtures containing H<sub>2</sub>, CH<sub>4</sub> and CO<sub>2</sub> with high boiling hydrocarbons: experimental equipment and results, *Chem. Eng. Process. Process Intensif.* 29 (1991) 155–164, doi:10.1016/0255-2701(91)85015-G.
- [92] H.-J. Ng, D.B. Robinson, Equilibrium-phase properties of the toluene-carbon dioxide system, *J. Chem. Eng. Data.* 23 (1978) 325–327, doi:10.1021/je60079a020.
- [93] K.-W. Cheng, M. Tang, Y.-P. Chen, Vapor-liquid equilibria of carbon dioxide with diethyl oxalate, ethyl laurate, and dibutyl phthalate binary mixtures at elevated pressures, *Fluid Phase Equilibria* 181 (2001) 1–16, doi:10.1016/S0378-3812(01)00415-0.
- [94] L. Chen, X. Fang, Phase equilibria and CO<sub>2</sub> distribution in the CO<sub>2</sub>-epoxide-toluene systems, *J. Nat. Gas Chem.* 3 (1994) 255–266.
- [95] H. Zhang, Z. Liu, B. Han, Critical points and phase behavior of toluene-CO<sub>2</sub> and toluene-H<sub>2</sub>-CO<sub>2</sub> mixture in CO<sub>2</sub>-rich region, *J. Supercrit. Fluids.* 18 (2000) 185–192, doi:10.1016/S0896-8446(00)00081-4.
- [96] C.J. Chang, The solubility of carbon dioxide in organic solvents at elevated pressures, *Fluid Phase Equilibria* 74 (1992) 235–242, doi:10.1016/0378-3812(92)85064-F.
- [97] C.J. Chang, C.-Y. Chen, H.-C. Lin, Solubilities of Carbon Dioxide and Nitrous Oxide in Cyclohexanone, Toluene, and N,N-Dimethylformamide at Elevated Pressures, *J. Chem. Eng. Data.* 40 (1995) 850–855, doi:10.1021/je00020a025.
- [98] A.L. Muhlbauer, J.D. Raal, Measurement and thermodynamic interpretation of high-pressure vapour-liquid equilibria in the toluene CO<sub>2</sub> system, *Fluid Phase Equilibria* 64 (1991) 213–236, doi:10.1016/0378-3812(91)90015-Y.
- [99] S. Yao, H. Chen, Z. Zhu, Gas-liquid equilibria of the carbon dioxide-toluene system, *Ranliao Huaxue Xuebao* 13 (1985) 297–304.
- [100] S. Park, C. Kim, C. Choi, Phase equilibria and mixture densities measurements of carbon dioxide-toluene system under high pressure, *Hwahak Konghak* 28 (1990) 438–443.
- [1001] M.J. Lazzaroni, D. Bush, J.S. Brown, C.A. Eckert, High-pressure vapor-liquid equilibria of some carbon dioxide + organic binary systems, *J. Chem. Eng. Data.* 50 (2005) 60–65, doi:10.1021/je0498560.
- [1002] J. Wu, Q. Pan, G.L. Rempel, Pressure-Density-Temperature Behavior of CO<sub>2</sub>/Acetone, CO<sub>2</sub>/Toluene, and CO<sub>2</sub>/Monochlorobenzene Mixtures in the Near-Critical Region, *J. Chem. Eng. Data.* 49 (2004) 976–979, doi:10.1021/je0342771.
- [1003] D.R. Cordray, J.J. Christensen, R.M. Izatt, The excess enthalpies of (carbon dioxide + toluene) at 308.15, 358.15, and 573.15 K from 6.98 to 16.63 MPa, *J. Chem. Thermodyn.* 18 (1986) 647–656, doi:10.1016/0021-9614(86)90066-2.
- [1004] D.R. Cordray, J.J. Christensen, R.M. Izatt, J.L. Oscarson, The excess enthalpies of (carbon dioxide + toluene) at 390.15, 413.15, 470.15, and 508.15 K from 7.60 to 17.50 MPa, *J. Chem. Thermodyn.* 20 (1988) 877–888, doi:10.1016/0021-9614(88)90077-8.
- [1005] C. Pando, J.A.R. Renuncio, R.S. Schofield, R.M. Izatt, J.J. Christensen, The excess enthalpies of (carbon dioxide + toluene) at 308.15, 385.15, and 413.15 K from 7.60 to 12.67 MPa, *J. Chem. Thermodyn.* 15 (1983) 747–755, doi:10.1016/0021-9614(83)90141-6.
- [1006] M. Baba, L. Dordain, J. Coxam, Calorimetric measurements of heat capacities and heats of mixing in the range 300–570 K and up to 30 MPa, *Indian J. Technol.* 30 (1992) 553–558.
- [1007] C.J. Wormald, J.M. Years, Excess molar enthalpies and excess molar volumes of {xCO<sub>2</sub> + (1-x)C<sub>6</sub>H<sub>5</sub>CH<sub>3</sub>} at 298.15, 304.10, and 308.15 K from 7.5 to 12.6 MPa, *J. Chem. Thermodyn.* 19 (1987) 845–856, doi:10.1016/0021-9614(87)90031-0.
- [1008] R.S. Mohamed, G.D. Holder, High pressure phase behavior in systems con-

- taining CO<sub>2</sub> and heavier compounds with similar vapor pressures, *Fluid Phase Equilibria* 32 (1987) 295–317, doi:10.1016/0378-3812(87)85060-4.
- [1009] J.H. Vera, H. Orbey, Binary vapor-liquid equilibria of carbon dioxide with 2-methyl-1-pentene, 1-hexene, 1-heptene, and m-xylene at 303.15, 323.15, and 343.15 K, *J. Chem. Eng. Data* 29 (1984) 269–272, doi:10.1021/je00037a012.
- [1010] M.C. Thies, M.E. Paulaitis, Vapor-liquid equilibrium for 1-methylnaphthalene/methanol mixtures at elevated temperatures and pressures, *J. Chem. Eng. Data* 29 (1984) 438–440, doi:10.1021/je00038a022.
- [1011] J. Zhang, L. Gao, X. Zhang, B. Zong, T. Jiang, B. Han, Phase Behaviors, Density, and Isothermal Compressibility of Styrene + CO<sub>2</sub>, Ethylbenzene + CO<sub>2</sub>, and Ethylbenzene + Styrene + CO<sub>2</sub> Systems, *J. Chem. Eng. Data* 50 (2005) 1818–1822, doi:10.1021/je0049546h.
- [1012] A. Bamberger, J. Schmelzer, D. Walther, G. Maurer, High-pressure vapour-liquid equilibria in binary mixtures of carbon dioxide and benzene compounds: experimental data for mixtures with ethylbenzene, isopropylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethenylbenzene and isopropenylbenzene, and their correlation with the generalized Bender and Skjold-Jørgensen's group contribution equation of state, *Fluid Phase Equilibria* 97 (1994) 167–189, doi:10.1016/0378-3812(94)85014-3.
- [1013] C.S. Tan, S.J. Yarn, J.H. Hsu, Vapor-liquid equilibria for the systems carbon dioxide-ethylbenzene and carbon dioxide-styrene, *J. Chem. Eng. Data* 36 (1991) 23–25, doi:10.1021/je00001a007.
- [1014] D. Robinson, S. Huang, The equilibrium phase properties of selected m-xylene and mesitylene binary systems: m-xylene-mesitylene-H<sub>2</sub>S, mesitylene-CO<sub>2</sub>, *Gas Process. Assoc. Res. Rep.* RR-43. (1980).
- [1015] R.N. Occhiogrosso, J.T. Igel, M.A. McHugh, Phase behavior of carbon dioxide-aromatic hydrocarbon mixtures, *Fluid Phase Equilibria* 26 (1986) 165–179, doi:10.1016/0378-3812(86)90004-X.
- [1016] H. Renon, S. Laugier, J. Schwartztruber, D. Richon, New determinations of high pressure vapor-liquid equilibria in binary systems containing n-propylbenzene with nitrogen or carbon dioxide consistent with the prausnitz-keeler test, *Fluid Phase Equilibria* 51 (1989) 285–298, doi:10.1016/0378-3812(89)80371-1.
- [1017] A. Bamberger, G. Maurer, High-pressure vapor-liquid equilibria in binary mixtures of carbon dioxide and aromatic hydrocarbons: Experimental data and correlation for CO<sub>2</sub> + acetophenone, CO<sub>2</sub> + 1-chloronaphthalene, CO<sub>2</sub> + methyl benzoate and CO<sub>2</sub> + n-propylbenzene, *J. Supercrit. Fluids* 7 (1994) 115–127, doi:10.1016/0896-8446(94)90048-5.
- [1018] D.L. Tiffin, A.L. DeVera, K.D. Luks, J.P. Kohn, Phase-equilibria behavior of the binary systems carbon dioxide-n-butylbenzene and carbon dioxide-trans-decalin, *J. Chem. Eng. Data* 23 (1978) 45–47, doi:10.1021/je60076a012.
- [1019] H.M. Sebastian, G.D. Nageshwar, H.-M. Lin, K.-C. Chao, Vapor-liquid equilibrium in binary mixtures of carbon dioxide + diphenylmethane and carbon dioxide + 1-methylnaphthalene, *J. Chem. Eng. Data* 25 (1980) 145–147, doi:10.1021/je60085a016.
- [1020] S.T. Chung, K.S. Shing, Multiphase behavior of binary and ternary systems of heavy aromatic hydrocarbons with supercritical carbon dioxide: Part I. Experimental results, *Fluid Phase Equilibria* 81 (1992) 321–341, doi:10.1016/0378-3812(92)85160-A.
- [1021] D.S. Jan, F.N. Tsai, Modeling phase behavior of carbon dioxide with aromatic solvents, *Ind. Eng. Chem. Res.* 30 (1991) 1965–1970, doi:10.1021/ie00056a045.
- [1022] D. Zhang, L. Wang, W. Sheng, B.C.Y. Lu, Experimental determination of P-X<sub>2</sub>-L-G critical locus and UCEP for Biphenyl-Co<sub>2</sub> mixtures, *Can. J. Chem. Eng.* 69 (1991) 1352–1356, doi:10.1002/cjce.5450690617.
- [1023] P.L. Cheong, D. Zhang, K. Ohgaki, B.C.-Y. Lu, High pressure phase equilibria for binary systems involving a solid phase, *Fluid Phase Equilibria* 29 (1986) 555–562, doi:10.1016/0378-3812(86)85054-3.
- [1024] M. McHugh, M.E. Paulaitis, Solid solubilities of naphthalene and biphenyl in supercritical carbon dioxide, *J. Chem. Eng. Data* 25 (1980) 326–329, doi:10.1021/je60087a018.
- [1025] R.A. Van Leer, M.E. Paulaitis, Solubilities of phenol and chlorinated phenols in supercritical carbon dioxide, *J. Chem. Eng. Data* 25 (1980) 257–259, doi:10.1021/je60086a020.
- [1026] B.C.-Y. Lu, D. Zhang, Solid-supercritical fluid phase equilibria, *Pure Appl. Chem.* 61 (1989) 1065–1074, doi:10.1351/pac198961061065.
- [1027] M. Yanagiuchi, T. Ueda, K. Matsubara, H. Inomata, K. Arai, S. Saito, Fundamental investigation on supercritical extraction of coal-derived aromatic compounds, *J. Supercrit. Fluids* 4 (1991) 145–151, doi:10.1016/0896-8446(91)90001-M.
- [1028] S. Mitra, J.W. Chen, D.S. Viswanath, Solubility and partial molar volumes of heavy aromatic hydrocarbons in super critical carbon dioxide, *J. Chem. Eng. Data* 33 (1988) 35–37, doi:10.1021/je00051a012.
- [1029] M.W. Barrick, J.M. Anderson, R.L. Robinson, Solubilities of carbon dioxide in naphthalene, phenanthrene, and pyrene at pressures to 10.6 MPa and temperatures from 373 to 433 K, *J. Chem. Eng. Data* 32 (1987) 372–374, doi:10.1021/je00049a026.
- [1030] S.-P. Hong, K.D. Luks, Multiphase equilibria of the mixture carbon dioxide + toluene + naphthalene, *Fluid Phase Equilibria* 74 (1992) 133–144, doi:10.1016/0378-3812(92)85058-G.
- [1031] Y. Tsekhanakaya, M. Iomtev, E. Mushkina, Solubility of naphthalene in ethylene and in carbon dioxide under pressure, *Zh. Fiz. Khim.* 38 (1964) 2166–2171.
- [1032] G.L. White, C.T. Lira, Multiphase behavior of carbon dioxide with solid aromatics, *Fluid Phase Equilibria* 78 (1992) 269–284, doi:10.1016/0378-3812(92)87041-K.
- [1033] H. Wang, T. Wang, Z. Shen, Solubility of diethyl ammonium diethyldithiocarbamate (Et<sub>2</sub>NH<sub>2</sub>D<sub>2</sub>DC) in supercritical carbon dioxide, *Gaoxiao Huaxue Gongcheng Xuebao* 15 (2001) 472–475.
- [1034] M. Shamsipur, A.R. Ghiasvand, Y. Yamini, Extraction of uranium from solid matrices using modified supercritical fluid CO<sub>2</sub>, *J. Supercrit. Fluids* 20 (2001) 163–169, doi:10.1016/S0896-8446(01)00052-3.
- [1035] H. Chang, D.G. Morrell, Solubilities of methoxy-1-tetralone and methyl nitrobenzoate isomers and their mixtures in supercritical carbon dioxide, *J. Chem. Eng. Data* 30 (1985) 74–78, doi:10.1021/je00039a025.
- [1036] E. Reverchon, P. Russo, A. Stassi, Solubilities of solid octacosane and triacontane in supercritical carbon dioxide, *J. Chem. Eng. Data* 38 (1993) 458–460, doi:10.1021/je00011a034.
- [1037] J.M. Dobbs, J.M. Wong, K.P. Johnston, Nonpolar co-solvents for solubility enhancement in supercritical fluid carbon dioxide, *J. Chem. Eng. Data* 31 (1986) 303–308, doi:10.1021/je00045a014.
- [1038] G.-T. Liu, K. Nagahama, Solubility of organic solid mixture in supercritical fluids, *J. Supercrit. Fluids* 9 (1996) 152–160, doi:10.1016/S0896-8446(96)90026-1.
- [1039] A. Stassi, R. Bettini, A. Gazzaniga, F. Giordano, A. Schiraldi, Assessment of solubility of ketoprofen and vanillic acid in supercritical CO<sub>2</sub> under dynamic conditions, *J. Chem. Eng. Data* 45 (2000) 161–165, doi:10.1021/je990114u.
- [1040] Q. Ren, B. Su, M. Huang, P. Wu, Solubility of Troeger's Base in Supercritical Carbon Dioxide, *J. Chem. Eng. Data* 45 (2000) 464–466, doi:10.1021/je9902903.
- [1041] A. Kalaga, M. Trebble, Density changes in supercritical solvent + hydrocarbon solute binary mixtures, *J. Chem. Eng. Data* 44 (1999) 1063–1066, doi:10.1021/je990029m.
- [1042] G. Madras, C. Erkey, A. Akgerman, A new technique for measuring solubilities of organics in supercritical fluids, *J. Chem. Eng. Data* 38 (1993) 422–423, doi:10.1021/je00011a024.
- [1043] Y. Iwai, H. Yamamoto, M. Sohda, Y. Tanaka, T. Shimizu, Y. Arai, Flow-type apparatus for measurement of solubilities of coal-derived components in supercritical fluid, *Mem. Kyushu Univ. Fac. Eng.* 49 (1989) 175–184.
- [1044] J.-W. Chen, F.-N. Tsai, Solubilities of methoxybenzoic acid isomers in supercritical carbon dioxide, *Fluid Phase Equilibria* 107 (1995) 189–200, doi:10.1016/0378-3812(95)02672-2.
- [1045] Y. Iwai, T. Fukuda, Y. Koga, Y. Arai, Solubilities of myristic acid, palmitic acid, and cetyl alcohol in supercritical carbon dioxide at 35.degree.C, *J. Chem. Eng. Data* 36 (1991) 430–432, doi:10.1021/je00004a025.
- [1046] M.R. Fat'hi, Y. Yamini, H. Sharghi, M. Shamsipur, Solubilities of Some 1,4-Dihydroxy-9,10-anthraquinone Derivatives in Supercritical Carbon Dioxide, *J. Chem. Eng. Data* 43 (1998) 400–402, doi:10.1021/je970266u.
- [1047] Y. Yamini, M.R. Fat'hi, N. Alizadeh, M. Shamsipur, Solubility of dihydroxybenzene isomers in supercritical carbon dioxide, *Fluid Phase Equilibria* 152 (1998) 299–305, doi:10.1016/S0378-3812(98)00385-9.
- [1048] M. Saucneau, J. Fages, J.-J. Letourneau, D. Richon, A novel apparatus for accurate measurements of solid solubilities in supercritical phases, *Ind. Eng. Chem. Res.* 39 (2000) 4609–4614, doi:10.1021/ie000181d.
- [1049] A. Hourri, J.M. St-Arnaud, T.K. Bose, Solubility of solids in supercritical fluids from the measurements of the dielectric constant: Application to CO<sub>2</sub>-naphthalene, *Rev. Sci. Instrum.* 69 (1998) 2732–2737, doi:10.1063/1.1149007.
- [1050] J. García-González, M.J. Molina, F. Rodríguez, F. Mirada, Solubilities of Phenol and Pyrocatechol in Supercritical Carbon Dioxide, *J. Chem. Eng. Data* 46 (2001) 918–921, doi:10.1021/je0003795.
- [1051] A. Diefenbacher, M. Türk, Phase equilibria of organic solid solutes and supercritical fluids with respect to the RESS process, *J. Supercrit. Fluids* 22 (2002) 175–184, doi:10.1016/S0896-8446(01)00123-1.
- [1052] R.A. Harris, M. Wilken, K. Fischer, T.M. Letcher, J.D. Raal, D. Ramjugernath, High pressure vapor-liquid equilibrium measurements of carbon dioxide with naphthalene and benzoic acid, *Fluid Phase Equilibria* 260 (2007) 60–64, doi:10.1016/j.fluid.2006.06.011.
- [1053] R. Qilong, S. Baogen, H. Mei, W. Pingdong, *Huagong Xuebao Chin Ed* 29 (2001) 52–54.
- [1054] D. Zudkevitch, N. Weinstein, T. Daubert, Present phase equilibrium data and correlations in view of needs for producing fluid fuels from coal, *Proc NPL Conf* (1978) 87–102.
- [1055] J.S. Yau, F.N. Tsai, Solubility of carbon dioxide in phenanthrene and in pyrene, *J. Chem. Eng. Data* 37 (1992) 295–297, doi:10.1021/je00007a005.
- [1056] C.H. Kim, A.B. Clark, P. Vimalchand, M.D. Donohue, High-pressure binary phase equilibria of aromatic hydrocarbons with carbon dioxide and ethane, *J. Chem. Eng. Data* 34 (1989) 391–395, doi:10.1021/je00058a005.
- [1057] R.J. Lee, K.C. Chao, Extraction of 1-methylnaphthalene and m-cresol with supercritical carbon dioxide and ethane, *Fluid Phase Equilibria* 43 (1988) 329–340, doi:10.1016/0378-3812(88)87013-4.
- [1058] C.J. Gregg, M. Radosz, Vapor-liquid equilibria for carbon dioxide and 1-methylnaphthalene: experiment and correlation, *Fluid Phase Equilibria* 86 (1993) 211–223, doi:10.1016/0378-3812(93)87177-3.
- [1059] L.E. Gutiérrez M, K.D. Luks, Three-Phase Liquid-Liquid-Vapor Equilibria of the Binary Mixture Carbon Dioxide + 1-Methylnaphthalene, *J. Chem. Eng. Data* 46 (2001) 679–682, doi:10.1021/je000322i.
- [1060] G.G. Haselden, P. Snowden, Equilibrium properties of the carbon dioxide + propylene and carbon dioxide + cyclopropane systems at low temperatures, *Trans. Faraday Soc.* 58 (1962) 1515–1528, doi:10.1039/TF9625801515.
- [1061] C.J. Eckert, S.I. Sandler, Vapor-liquid equilibria for the carbon dioxide-

- cyclopentane system at 37.7, 45.0, and 60.0 degree.C, J. Chem. Eng. Data. 31 (1986) 26–28, doi:10.1021/je00043a008.
- [1062] P. Marathe, S.I. Sandler, High-pressure vapor-liquid equilibrium of some binary mixtures of cyclopentane, argon, nitrogen, n-butane, and neopentane, J. Chem. Eng. Data. 36 (1991) 192–197, doi:10.1021/je00002a015.
- [1063] N.N. Shah, J.A. Zollweg, W.B. Streett, Vapor-liquid equilibrium in the system carbon dioxide + cyclopentane from 275 to 493 K at pressures to 12.2 MPa, J. Chem. Eng. Data. 36 (1991) 188–192, doi:10.1021/je00002a014.
- [1064] S. Vitu, J.-N. Jaubert, J. Pauly, J.-L. Daridon, D. Barth, Phase equilibria measurements of CO<sub>2</sub> + methyl cyclopentane and CO<sub>2</sub> + isopropyl cyclohexane binary mixtures at elevated pressures, J. Supercrit. Fluids. 44 (2008) 155–163, doi:10.1016/j.supflu.2007.10.003.
- [1065] I. Krichevskii, G. Sorina, Gas-liquid phase equilibria in the systems cyclohexane-carbon dioxide and cyclohexane-nitrous oxide, Zh. Fiz. Khim. 34 (1960) 1420–1424.
- [1066] S.K. Shibata, S.I. Sandler, High pressure vapor-liquid equilibria of mixtures of nitrogen, carbon dioxide, and cyclohexane, J. Chem. Eng. Data. 34 (1989) 419–424, doi:10.1021/je00058a014.
- [1067] T.A. Al-Sahhaf, R.S. Al-Ameeri, S.E.M. Hamam, Bubble point measurements for the ternary system: Carbon dioxide, cyclohexane and naphthalene, Fluid Phase Equilibria 53 (1989) 31–37, doi:10.1016/0378-3812(89)80070-6.
- [1068] M. Mukhopadhyay, P. Srinivas, Multicomponent Solubilities of Reactants and Products of Cyclohexane Oxidation in Supercritical Carbon Dioxide, Ind. Eng. Chem. Res. 35 (1996) 4713–4717, doi:10.1021/ie9601155.
- [1069] N. Zhang, X. Zheng, High pressure vapor-liquid equilibria of two binary systems containing CO<sub>2</sub>, Nat. Gas Chem. Ind. 22 (1997) 54–57.
- [1070] Y. Feng, W. Hu, Y. Hou, Gas-liquid equilibria for carbon dioxide-cyclohexane and carbon dioxide-cyclohexanone systems, Gaixiao Huaxue Gongcheng Xuebao 6 (1992) 19–24.
- [1071] D.R. Cordray, R.M. Izatt, J.J. Christensen, The excess enthalpies of (carbon dioxide + cyclohexane) at 390.15, 413.15, 438.15, 498.15, and 508.15 K from 7.50 to 14.39 MPa, J. Chem. Thermodyn. 20 (1988) 225–234, doi:10.1016/0021-9614(88)90157-7.
- [1072] J.J. Christensen, T.A.C. Walker, D.R. Cordray, R.M. Izatt, The excess enthalpies of (carbon dioxide + cyclohexane) at 470.15, 553.15, and 573.15 K from 7.50 to 12.50 MPa, J. Chem. Thermodyn. 19 (1987) 47–56, doi:10.1016/0021-9614(87)90161-3.
- [1073] K. Nasrifar, M.M. Mooijer-van den Heuvel, C.J. Peters, S. Ayatollahi, M. Moshfeghian, Measurements and modeling of bubble points in binary carbon dioxide systems with tetrahydropyran and methylcyclohexane, Fluid Phase Equilibria 204 (2003) 1–14, doi:10.1016/S0378-3812(02)00204-2.
- [1074] H.-J. Ng, D.B. Robinson, The equilibrium phase properties of selected naphthenic binary systems: Carbon dioxide-methylcyclohexane, hydrogen sulfide-methylcyclohexane, Fluid Phase Equilibria 2 (1979) 283–292, doi:10.1016/0378-3812(79)80013-8.
- [1075] H. Zhang, B. Han, Z. Hou, Z. Liu, Measurement of critical points of the methylcyclohexane (MCH)-H<sub>2</sub>-CO<sub>2</sub> system in the CO<sub>2</sub>-rich region, Fluid Phase Equilibria 179 (2001) 131–138, doi:10.1016/S0378-3812(00)00487-8.
- [1076] H.M. Sebastian, G.D. Nageshwar, H.M. Lin, K.C. Chao, Gas-liquid equilibria in mixtures of carbon dioxide and tetralin at elevated temperatures, Fluid Phase Equilibria 4 (1980) 257–260, doi:10.1016/0378-3812(80)80019-7.
- [1077] D. Walther, G. Maurer, High-pressure vapor-liquid equilibria for carbon dioxide + benzonitrile, CO<sub>2</sub> + benzyl alcohol, CO<sub>2</sub> + 2-tert-butylphenol, CO<sub>2</sub> + methoxybenzene, and CO<sub>2</sub> + 1,2,3,4-tetrahydronaphthalene at temperatures between 313 and 393 K and pressures up to 20 MPa, J. Chem. Eng. Data. 38 (1993) 247–249, doi:10.1021/je00010a016.
- [1078] H. Byun, C. Kim, C. Kwak, High pressure phase equilibria of carbon dioxide-tetralone and carbon dioxide-tetralone-tetralin system, Hwahak Konghak 31 (1993) 94–98.
- [1079] H. Byun, C. Kim, C. Kwak, High pressure binary phase equilibria of carbon dioxide-tetralin system, Hwahak Konghak 30 (1992) 387–392.
- [1080] M. Mukhopadhyay, S.K. De, Fluid phase behavior of close molecular weight fine chemicals with supercritical carbon dioxide, J. Chem. Eng. Data. 40 (1995) 909–913, doi:10.1021/je00020a038.
- [1081] J.R. DiAndrèth, J.M. Ritter, M.E. Paulaitis, Experimental technique for determining mixture compositions and molar volumes of three or more equilibrium phases at elevated pressures, Ind. Eng. Chem. Res. 26 (1987) 337–343, doi:10.1021/ie00062a027.
- [1082] H. Inomata, K. Arai, S. Saito, Measurement of vapor-liquid equilibria at elevated temperatures and pressures using a flow type apparatus, Fluid Phase Equilib. 29 (1986) 225–232.
- [1083] J.A. Hudziak, H. Kahvand, M. Yassaie, S. Leipziger, Dew point measurements for nitrogen-propane and nitrogen-butane mixtures, J. Chem. Eng. Data. 29 (1984) 296–301, doi:10.1021/je00037a022.
- [1084] L. Gausø, A. Fredenslund, J. Møllerup, Vapour-liquid equilibrium data for the systems C<sub>2</sub>H<sub>6</sub> + N<sub>2</sub>, C<sub>2</sub>H<sub>4</sub> + N<sub>2</sub>, C<sub>3</sub>H<sub>8</sub> + N<sub>2</sub>, and C<sub>3</sub>H<sub>6</sub> + N<sub>2</sub>, Fluid Phase Equilibria 1 (1977) 13–26, doi:10.1016/0378-3812(77)80022-8.
- [1085] D. Schindler, G. Swift, F. Kurata, More Low Temperature V-L Design Data, Hydrocarb. Process. 45 (1966) 205–210.
- [1086] P. Bol'shakov, Solubility of a 1:3 nitrogen-hydrogen mixture in liquid ammonia at high pressures, Tr Gos Nauchno Issled Proektn Inst Azotn Promst Prod Org Sin 4 (1954) 12–17.
- [1087] M. Rozhnov, V. Kozya, V. Zhdanov, Phase ratios in twocomponent systems of C<sub>1</sub>-3 hydrocarbons and nitrogen, Khim Promst Mosc 11 (1988) 674–675.
- [1088] M. Yorizane, S. Sadamoto, S. Yoshimura, H. Masuoka, N. Shiki, T. Kimura, A. Toyama, Low temperature vapor-liquid equilibria. Nitrogen-propylene and carbon monoxide-methane systems, Kagaku Kogaku 32 (1968) 257–264.
- [1089] W. Akers, L. Attwell, J. Robinson, Volumetric and phase behavior of nitrogen-hydrocarbon systems. Nitrogen-butane system, J. Ind. Eng. Chem. 46 (1954) 2539–2540.
- [1090] L.R. Roberts, J.J. McKetta, Vapor-liquid equilibrium in the n-butane-nitrogen system, AIChE J 7 (1961) 173–174, doi:10.1002/aic.690070137.
- [1091] R. Sauer, Ph.D. Thesis, University of Texas, Austin, TX, 1959.
- [1092] H. Steinbach, M. Steinbrecher, Solubility of nitrogen C<sub>4</sub>- liquefied gases, Chem Tech Leipz. Ger. 18 (1966) 633.
- [1093] M.K.F. Malewski, S.I. Sandler, High-pressure vapor-liquid equilibria of the binary mixtures nitrogen + n-butane and argon + n-butane, J. Chem. Eng. Data. 34 (1989) 424–426, doi:10.1021/je00058a015.
- [1094] W.R. Lehigh, J.J. McKetta, Vapor-Liquid Equilibrium in the Ethane-n-Nitrogen System, J. Chem. Eng. Data. 11 (1966) 180–182, doi:10.1021/je60029a015.
- [1095] V. Skripka, S. Barsuk, I. Nikitina, Liquid-vapor equilibria in a nitrogen-n-butane system, Gazov Promst 14 (1969) 41–45.
- [1096] K.D. Wisotzki, G.M. Schneider, Fluid Phase Equilibria of the Binary Systems N<sub>2</sub> + Ethane and N<sub>2</sub> + Pentane Between 88 K and 313 K and at Pressures up to 200 MPa, Berichte Bunsenges. Für Phys. Chem. 89 (1985) 21–25, doi:10.1002/bbpc.19850890106.
- [1097] G. Silva-Oliver, G. Eliosa-Jiménez, F. García-Sánchez, J.R. Avendaño-Gómez, High-pressure vapor-liquid equilibria in the nitrogen-n-pentane system, Fluid Phase Equilibria 250 (2006) 37–48, doi:10.1016/j.fluid.2006.09.018.
- [1098] H. Kalra, D.B. Robinson, G.J. Besserer, The equilibrium phase properties of the nitrogen-n-pentane system, J. Chem. Eng. Data. 22 (1977) 215–218, doi:10.1021/je60073a023.
- [1099] F. Kurata, G.W. Swift, Experimental Measurements of Vapor-Liquid Equilibrium Data for the Ethane - Carbon Dioxide and Nitrogen - n-Pentane Binary Systems, GPA Res. Rep. (1971) 1–10.
- [1100] G. Eliosa-Jiménez, G. Silva-Oliver, F. García-Sánchez, A. de Ita de la Torre, High-Pressure Vapor-Liquid Equilibria in the Nitrogen + n-Hexane System, J. Chem. Eng. Data. 52 (2007) 395–404, doi:10.1021/je060341d.
- [1101] R.S. Poston, J.J. McKetta, Vapor-Liquid Equilibrium in the n-Hexane-Nitrogen System, J. Chem. Eng. Data. 11 (1966) 364–365, doi:10.1021/je60030a022.
- [1102] F. García-Sánchez, G. Eliosa-Jiménez, G. Silva-Oliver, B.E. García-Flores, Vapor-Liquid Equilibrium Data for the Nitrogen + n-Decane System from (344 to 563) K and at Pressures up to 50 MPa, J. Chem. Eng. Data. 54 (2009) 1560–1568, doi:10.1021/je800881t.
- [1103] S. Peter, H. Eicke, Phase equilibrium in the systems nitrogenn- heptane, nitrogen-2,2,4-trimethylpentane, and nitrogen-methylcyclohexane at higher pressures and temperatures, Ber Bunsen-Ges 74 (1970) 190–194.
- [1104] W.W. Akers, D.M. Kehn, C.H. Kilgore, Volumetric and Phase Behavior of Nitrogen-Hydrogen Systems: Nitrogen-n-Heptane System, Ind. Eng. Chem. 46 (1954) 2536–2539, doi:10.1021/ie50540a040.
- [1105] D. Legret, D. Richon, H. Renon, Vapor liquid equilibria up to 100 MPa: A new apparatus, AIChE J 27 (1981) 203–207, doi:10.1002/aic.690270205.
- [1106] P. Figuiere, J.F. Hom, S. Laugier, H. Renon, D. Richon, H. Szwarc, Vapor-liquid equilibria up to 40,000 KPa and 400 °C: A new static method, AIChE J 26 (1980) 872–875, doi:10.1002/aic.690260526.
- [1107] F.M. Llave, T.H. Chung, Vapor-liquid equilibria of nitrogen-hydrocarbon systems at elevated pressures, J. Chem. Eng. Data. 33 (1988) 123–128, doi:10.1021/je00052a019.
- [1108] G. Brunner, S. Peter, H. Wenzel, Phase equilibrium in the systems n-heptane-nitrogen, methylcyclohexane-nitrogen and n-heptane-methylcyclohexane-nitrogen at high pressures, Chem. Eng. J. 7 (1974) 99–104, doi:10.1016/0300-9467(74)85002-1.
- [1109] E.H. Boomer, C.A. Johnson, A.G.A. Piercey, Equilibria in two-phase, gas-liquid hydrocarbon systems: iv. methane and heptane, Can. J. Res. 16b (1938) 396–410, doi:10.1139/cjr38b-050.
- [1110] H. Schlichting, Ph.D. Thesis, TU Berlin, Berlin, Germany, 1991.
- [1111] G. Silva-Oliver, G. Eliosa-Jiménez, F. García-Sánchez, J.R. Avendaño-Gómez, High-pressure vapor-liquid equilibria in the nitrogen-n-nonane system, J. Supercrit. Fluids. 42 (2007) 36–47, doi:10.1016/j.supflu.2007.01.006.
- [1112] E.B. Graham, K.E. Weale, J.F. Masi, D.H. Tsai (Eds.), The solubility of compressed gases in non-polar liquids, Prog. Int. Res. Thermodyn. Transp. Prop. (1962) 153–158, doi:10.1016/B978-1-4832-0083-5.50018-X.
- [1113] J.L. Daridon, B. Lagourette, P. Xans, Thermodynamic properties of liquid mixtures containing gas under pressure based on ultrasonic measurements, Fluid Phase Equilibria 100 (1994) 269–282, doi:10.1016/0378-3812(94)80014-6.
- [1114] G. Ghanem, G. Tagand, H. Loiseleur, Determination of the solubility of liquid tetrahydrothiophene in the principal constituents of natural gas (CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>) by a dynamic device with vapor-phase chromatography analysis, J. Chim Phys Phys Chim Biol 95 (1998) 927–946.
- [1115] A. Azarmooosh, J.J. McKetta, Nitrogen-n-Decane System in the Two-Phase Region, J. Chem. Eng. Data. 8 (1963) 494–496, doi:10.1021/je60019a005.
- [1116] J. Tong, W. Gao, Robert L. Robinson, K.A.M. Gasem, Solubilities of nitrogen in heavy normal paraffins from 323 to 423 K at Pressures to 18.0 MPa, J. Chem. Eng. Data. 44 (1999) 784–787, doi:10.1021/je980279n.
- [1117] R. Srinivasan, Ph.D. Thesis, Illinois Institute of Technology, Chicago, 1981.
- [1118] D.L. Pearce, C.J. Peters, J. de Swaan Arons, Measurement of the gas phase solubility of decane in nitrogen, Fluid Phase Equilibria 89 (1993) 335–343, doi:10.1016/0378-3812(93)85092-Z.
- [1119] R.J. Wilcock, R. Battino, W.F. Danforth, E. Wilhelm, Solubilities of gases in liquids II. The solubilities of He, Ne, Ar, Kr, O<sub>2</sub>, N<sub>2</sub>, CO, CO<sub>2</sub>, CH<sub>4</sub>, CF<sub>4</sub>, and

- SF6 in n-octane 1-octanol, n-decane, and 1-decanol, *J. Chem. Thermodyn.* 10 (1978) 817–822, doi:10.1016/0021-9614(78)90154-4.
- [1120] S. Rupperecht, G. Faeth, Investigation of air solubility in jet A fuel at high pressures, Report Contract No. 3422, National Aeronautics and Space Administration (NASA), 1981, (n.d.).
- [1121] W. Gao, R.L. Robinson, K.A.M. Gasem, High-Pressure solubilities of hydrogen, nitrogen, and carbon monoxide in dodecane from 344 to 410 K at pressures to 13.2 MPa, *J. Chem. Eng. Data.* 44 (1999) 130–132, doi:10.1021/jc9801664.
- [1122] R. Sultanov, V. Skripka, A. Namiot, Phase equilibria of methane and nitrogen with high-boiling hydrocarbons, *GazoV Delo* 10 (1972) 43–46.
- [1123] H.-M. Lin, H. Kim, K.-C. Chao, Gas-liquid equilibria in nitrogen + n-hexadecane mixtures at elevated temperatures and pressures, *Fluid Phase Equilibria* 7 (1981) 181–185, doi:10.1016/0378-3812(81)85020-0.
- [1124] R. Sultanov, V. Skripka, A. Namiot, Phase equilibria in the system water-n-hexadecane at elevated temperatures, *VINITI Database (1971) 3139–3171 Pp 1–11.* (n.d.).
- [1125] H. Kalra, H.-J. Ng, R.D. Miranda, D.B. Robinson, Equilibrium phase properties of the nitrogen-isobutane system, *J. Chem. Eng. Data.* 23 (1978) 321–324, doi:10.1021/jc60079a022.
- [1126] D. Robinson, H. Kalra, The equilibrium phase properties of selected binary systems: n-heptane-hydrogen sulfide, n-heptane-carbon dioxide and i-butane-nitrogen; Gas Processors Association, Research Report RR-18, (1976).
- [1127] G. Chen, H. Knapp, Y. Hou, Vapor-liquid equilibria for the nitrogen-isobutane system, *J. Solut. Chem.* 26 (1997) 779–790, doi:10.1007/BF02767783.
- [1128] T.R. Krishnan, H. Kalra, D.B. Robinson, The equilibrium phase properties of the nitrogen-isopentane system, *J. Chem. Eng. Data.* 22 (1977) 282–285, doi:10.1021/jc60074a012.
- [1129] H. Reising, G.M. Schneider, Fluid-phase and crystallization equilibria of the binary system nitrogen + dimethylpropane between 190 and 300 K and at pressures up to 200 MPa, *Fluid Phase Equilibria* 45 (1989) 103–114, doi:10.1016/0378-3812(89)80169-4.
- [1130] S.D. Chang, B.C.Y. Lu, Vapor-liquid equilibria in the nitrogen-methane-ethane system, *Chem. Eng. Prog. Symp. Ser. U. S. 63* (1967) 81 <https://www.osti.gov/biblio/5987627>. (accessed October 3, 2019).
- [1131] M. Cines, J. Roach, R. Hogan, Nitrogen-methane vapor-liquid equilibria, *Chem. Eng. Prog. Symp. Ser. 49* (1953) 1–10.
- [1132] O. Bloomer, J. Parent, Liquid-vapor phase behavior of the methane-nitrogen system, *Chem. Eng. Prog. Symp. Ser. 49* (1953) 11–24.
- [1133] V.G. Skripka, I.E. Nikitina, L.A. Zhdanovich, A.G. Sirotnin, O.A. Ben'yaminovich, Liquid-vapor phase equilibria at low temperatures in binary systems formed by components of natural gas, *Gazov Promst* 15 (1970) 35–36.
- [1134] S. Fuks, A. Bellemans, Excess free energies and volumes of two simple binary liquid mixtures: methane-krypton and nitrogen-methane, *Bull. Sociétés Chim. Belg.* 76 (1967) 290–299, doi:10.1002/bscb.19670760503.
- [1135] D.W. McClure, K.L. Lewis, R.C. Miller, L.A.K. Staveley, Excess enthalpies and Gibbs free energies for nitrogen + methane at temperatures below the critical point of nitrogen, *J. Chem. Thermodyn.* 8 (1976) 785–792, doi:10.1016/0021-9614(76)90057-4.
- [1136] F.B. Sprow, J.M. Prausnitz, Vapor-Liquid equilibria for five cryogenic mixtures, *AIChE J.* 12 (1966) 780–784, doi:10.1002/aic.690120427.
- [1137] W.R. Parrish, M.J. Hiza, Liquid-vapor equilibria in the nitrogen-methane system between 95 and 120 K, in: K.D. Timmerhaus (Ed.), *Adv. Cryog. Eng.*, Springer US, Boston, MA, 1995, pp. 300–308, doi:10.1007/978-1-4613-9847-9\_37.
- [1138] R. Stryjek, P.S. Chappellear, R. Kobayashi, Low-temperature vapor-liquid equilibria of nitrogen-methane system, *J. Chem. Eng. Data.* 19 (1974) 334–339, doi:10.1021/jc60063a023.
- [1139] A.J. Kidnay, R.C. Miller, W.R. Parrish, M.J. Hiza, Liquid-vapor phase equilibria in the N<sub>2</sub>-CH<sub>4</sub> system from 130 to 180 K, *Cryogenics* 15 (1975) 531–540, doi:10.1016/0011-2275(75)90149-6.
- [1140] R.C. Miller, A.J. Kidnay, M.J. Hiza, Liquid-vapor equilibria at 112.00 K for systems containing nitrogen, argon, and methane, *AIChE J.* 19 (1973) 145–151, doi:10.1002/aic.690190121.
- [1141] V. Fastovskii, Y. Petrovskii, Liquid and vapor equilibria in the nitrogen-methane system, *Zh. Fiz. Khim.* 31 (1957) 2317–2320.
- [1142] R.T. Ellington, B.E. Eakin, J.D. Parent, D.C. Gami, O.T. Bloomer, Vapor-liquid phase equilibria in the binary systems of CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, and N<sub>2</sub>, *Thermodyn. Transp. Prop. Gases Liq. Solids Pap. Present. Symp. Therm. Prop.* 1 (1959) 180–194.
- [1143] H. Cheung, D.I.-J. Wang, Solubility of Volatile Gases in Hydrocarbon Solvents at Cryogenic Temperatures, *Ind. Eng. Chem. Fundam.* 3 (1964) 355–361, doi:10.1021/i160012a014.
- [1144] H. Kremer, PhD thesis, University of Berlin, 1982.
- [1145] L.W. Brandt, Lowell. Stroud, Phase Equilibria in Natural Gas Systems. Apparatus with Windowed Cell for 800 P.S.I.G. and Temperatures to –320° F, *Ind. Eng. Chem.* 50 (1958) 849–852, doi:10.1021/jc50581a046.
- [1146] H. Kremer, H. Knapp, Vapor-liquid equilibria in ternary mixtures of H<sub>2</sub>, N<sub>2</sub>, CO and CH<sub>4</sub>, *Fluid Phase Equilibria* 11 (1983) 289–310, doi:10.1016/0378-3812(83)85030-4.
- [1147] K.L. Lewis, S.E. Mosedale, C.J. Wormald, The enthalpies of mixing of methane + argon, methane + nitrogen, and methane + hydrogen in the gaseous and two-phase regions, *J. Chem. Thermodyn.* 9 (1977) 121–131, doi:10.1016/0021-9614(77)90077-5.
- [1148] C.J. Wormald, K.L. Lewis, S. Mosedale, The excess enthalpies of hydrogen + methane, hydrogen + nitrogen, methane + nitrogen, methane + argon, and nitrogen + argon at 298 and 201 K at pressures up to 10.2 MPa, *J. Chem. Thermodyn.* 9 (1977) 27–42, doi:10.1016/0021-9614(77)90194-X.
- [1149] K. Liu, W. Wang, *Huagong Xuebao* 16 (1988) 58–63.
- [1150] B. Eakin, R. Ellington, D. Gami, Physical-chemical properties of ethane-nitrogen mixtures, *Inst. Gas Technol. Res. Bull.* (1955) 26.
- [1151] M.J. Hiza, W.M. Haynes, W.R. Parrish, Orthobaric liquid densities and excess volumes for binary mixtures of low molar mass alkanes and nitrogen between 105 and 140 K, *J. Chem. Thermodyn.* 9 (1977) 873–896, doi:10.1016/0021-9614(77)90173-2.
- [1152] P. Yu, I.M. Elshayal, B.C.-Y. Lu, Liquid-liquid-vapor equilibria in the nitrogen-methane-ethane system, *Can. J. Chem. Eng.* 47 (1969) 495–498, doi:10.1002/cjce.5450470516.
- [1153] H. Kremer, H. Knapp, Three-phase conditions are predictable, *Hydrocarb. Process U. S. 62* (1983) 4 <https://www.osti.gov/biblio/5678094>. (accessed October 13, 2019).
- [1154] H.J.R. Guedes, J.A. Zollweg, E.J.M. Filipe, L.F.G. Martins, J.C.G. Calado, Thermodynamics of liquid (nitrogen + ethane), *J. Chem. Thermodyn.* 34 (2002) 669–678, doi:10.1006/jcht.2001.0936.
- [1155] R. Stryjek, P.S. Chappellear, R. Kobayashi, Low-temperature vapor-liquid equilibria of nitrogen-ethane system, *J. Chem. Eng. Data.* 19 (1974) 340–343, doi:10.1021/jc60063a024.
- [1156] S. Zeck, H. Knapp, Vapor-liquid and vapor-liquid-liquid phase equilibria for binary and ternary systems for nitrogen, ethane and methanol: Experiment and data reduction, *Fluid Phase Equilibria* 25 (1986) 303–322, doi:10.1016/0378-3812(86)80006-1.
- [1157] T.S. Brown, E.D. Sloan, A.J. Kidnay, Vapor-liquid equilibria in the nitrogen + carbon dioxide + ethane system, *Fluid Phase Equilibria* 51 (1989) 299–313, doi:10.1016/0378-3812(89)80372-3.
- [1158] G. Raabe, J. Janisch, J. Koehler, Experimental studies of phase equilibria in mixtures relevant for the description of natural gases, *Fluid Phase Equilibria* 185 (2001) 199–208, doi:10.1016/S0378-3812(01)00470-8.
- [1159] G. Raabe, J. Köhler, Phase equilibria in the system nitrogen-ethane and their prediction using cubic equations of state with different types of mixing rules, *Fluid Phase Equilibria* 222–223 (2004) 3–9, doi:10.1016/j.fluid.2004.06.001.
- [1160] J.C.G. Calado, P. Gopal, J.A. Zollweg, W.R. Thompson, Heat-of-mixing for the partially miscible system N<sub>2</sub>/C<sub>2</sub>H<sub>6</sub>, *Can. J. Chem.* 66 (1988) 626–627, doi:10.1139/v88-107.
- [1161] I. Krichevskii, D. Gamburg, Solubility of liquids in compressed gases-solubility of benzene in compressed nitrogen, *Acta Physicochim URSS* 16 (1942) 362–375.
- [1162] I. Krichevskii, G. Efreanova, Phase and volume relations in liquid-gas systems at high pressures, *Zh. Fiz. Khim.* 22 (1948) 1116–1125.
- [1163] P. Miller, B.F. Dodge, THE SYSTEM BENZENE-NITROGEN Liquid-Vapor Phase Equilibria at Elevated Pressures, *Ind. Eng. Chem.* 32 (1940) 434–438, doi:10.1021/jc50363a037.
- [1164] W.K. Lewis, C.D. Luke, Vapor-Liquid Equilibria of Hydrocarbons at High Pressures, *Ind. Eng. Chem.* 25 (1933) 725–727, doi:10.1021/jc50283a004.
- [1165] W. Gao, K.A.M. Gasem, R.L. Robinson, Solubilities of Nitrogen in Selected Naphthenic and Aromatic Hydrocarbons at Temperatures from 344 to 433 K and Pressures to 22.8 MPa, *J. Chem. Eng. Data.* 44 (1999) 185–189, doi:10.1021/jc980187y.
- [1166] V.V. de Leeuw, W. Poot, Th.W.de Loos, J. de Swaan Arons, High pressure phase equilibria of the binary systems N<sub>2</sub> + benzene, N<sub>2</sub> + p-xylene and N<sub>2</sub> + naphthalene, *Fluid Phase Equilibria* 49 (1989) 75–101, doi:10.1016/0378-3812(89)80007-X.
- [1167] C.J. Wormald, E.J. Lewis, A.J. Terry, Second virial coefficients of benzene and cyclohexane from measurements of the excess molar enthalpy of (0.5N<sub>2</sub>+0.5C<sub>6</sub>H<sub>6</sub>) and (0.5N<sub>2</sub>+0.5C<sub>6</sub>H<sub>12</sub>) from 333.2 K to 433.2 K, *J. Chem. Thermodyn.* 28 (1996) 17–27, doi:10.1006/jcht.1996.0004.
- [1168] D. Richon, S. Laugier, H. Renon, High-pressure vapor-liquid equilibrium data for binary mixtures containing molecular nitrogen, carbon dioxide, hydrogen sulfide and an aromatic hydrocarbon or propylcyclohexane in the range 313–473 K, *J. Chem. Eng. Data.* 37 (1992) 264–268, doi:10.1021/jc00006a035.
- [1169] H. Lin, M.-J. Lee, R.-J. Lee, Phase Equilibria of Toluene in Mixtures with Helium or Nitrogen at High Temperatures, *J. Chem. Eng. Data.* 40 (1995) 653–656, doi:10.1021/jc00019a027.
- [1170] D. Tsiklis, L. Shenderei, A. El'natanov, Phase and volume relations in the system toluene-nitrogen, *Khim Promst Mosc* 5 (1963) 348–353.
- [1171] H.-M. Lin, M.-J. Lee, R.-J. Lee, High-Temperature Phase Equilibria for Asymmetric Mixtures of Helium + m-Xylene and Nitrogen + m-Xylene, *Ind. Eng. Chem. Res.* 34 (1995) 4524–4530, doi:10.1021/ie00039a046.
- [1172] H.M. Lin, H. Kim, K.C. Chao, Vapor-liquid equilibrium in nitrogen + 1-methylnaphthalene mixtures at elevated temperatures and pressures, *Fluid Phase Equilibria* 10 (1983) 73–76, doi:10.1016/0378-3812(83)80005-3.
- [1173] S. Khodeeva, Liquid-gas equilibrium in the cyclohexanenitrogen-oxygen system, *Tr Gos Nauchno Issled Proekt Inst Azotn Promst Prod Org Sin* 12 (1971) 30–39.
- [1174] C.J. Wormald, A new gas phase flow mixing calorimeter: test measurements on (nitrogen+cyclohexane), *J. Chem. Thermodyn* 29 (1997) 701–714, doi:10.1006/jcht.1997.0191.
- [1175] D. Robinson, S. Huang, A. Leu, Equilibrium Phase Properties of Selected Naphthenic Binary Systems: Methylcyclohexane - Nitrogen, Ethylcyclohexane-Hydrogen Sulfide, n-Propylcyclohexane-Hydrogen Sulfide. Gas Processors Association. Research Report RR-51, 1981.
- [1176] E. Lebedeva, A. Kashirina, V. Grokhol'skaya, Phase equilibria in the

- methylcyclohexane-nitrogen system and the partition coefficients of methylated cyclic ketones and alcohols between methylcyclohexane and water, *Tr Gos Nauchno Issled Proekt Inst Azotn Promst Prod Org Sin* 22 (1973) 9–16.
- [1177] H. Kim, W. Wang, H.M. Lin, K.C. Chao, Vapor-liquid equilibria in binary mixtures of nitrogen + tetralin and nitrogen + m-cresol, *J. Chem. Eng. Data* 28 (1983) 216–218, doi:10.1021/je00032a028.
- [1178] G. Zenner, L. Dana, Liquid-vapor equilibrium compositions of carbon dioxide-oxygen-nitrogen mixtures, *Chem Eng Prog Symp Ser* 59 (1963) 36–41.
- [1179] I. Al-Wakeel, PhD Thesis TU Berl, Berl. Ger., 1976.
- [1180] N.K. Muirbrook, J.M. Prausnitz, Multicomponent vapor-liquid equilibria at high pressures: Part I. Experimental study of the nitrogen-oxygen-carbon dioxide system at 0°C, *AIChE J* 11 (1965) 1092–1096, doi:10.1002/aic.690110624.
- [1181] W. Weber, S. Zeck, H. Knapp, Gas solubilities in liquid solvents at high pressures: apparatus and results for binary and ternary systems of N<sub>2</sub>, CO<sub>2</sub> and CH<sub>3</sub>OH, *Fluid Phase Equilibria* 18 (1984) 253–278, doi:10.1016/0378-3812(84)85011-6.
- [1182] T.A. Al-Sahhaf, Vapor-liquid equilibria for the ternary system N<sub>2</sub>+CO<sub>2</sub>+CH<sub>4</sub> at 230 and 250 K, *Fluid Phase Equilibria* 55 (1990) 159–172, doi:10.1016/0378-3812(90)85010-8.
- [1183] I. Krichevskii, N. Khazanova, Liquid-gas equilibrium in the nitrogen-carbon dioxide system under elevated pressures, *Khim Promst Mosc* (1962) 169–171.
- [1184] M. Yorizane, S. Yoshimura, H. Masuoka, Y. Miyano, Y. Kakimoto, New procedure for vapor-liquid equilibria. Nitrogen + carbon dioxide, methane + Freon 22, and methane + Freon 12, *J. Chem. Eng. Data* 30 (1985) 174–176, doi:10.1021/je00040a012.
- [1185] M. Yorizane, Determination of vapor-liquid equilibrium data at high pressure and low temperature, *Asahi Garasu Kogyo Gijutsu Shoreikai Kenkyu Hokoku* 18 (1971) 61–76.
- [1186] M. Yorizane, S. Yoshimura, H. Masuoka, M. Nakamura, Prediction of High Pressure Vapor-Liquid Equilibria for Multicomponent Systems by the BWR Equation of State, *J. Chem. Eng. Jpn.* 4 (1971) 10–16, doi:10.1252/jcej.4.10.
- [1187] X. Yang, Contribution to the experimental investigation and calculation of Vapor-Liquid Phase Equilibria (1991).
- [1188] Z. Zhang, L. Guo, X. Yang, Vapor and liquid equilibrium for nitrogen-ethane-carbon dioxide ternary system, *Huagong Xuebao* 50 (1999) 392–398.
- [1189] A.V. Hejmadi, D.L. Katz, J.E. Powers, Experimental determination of the enthalpy of mixing of N + CO<sub>2</sub> under pressure, *J. Chem. Thermodyn.* 3 (1971) 483–496, doi:10.1016/S0021-9614(71)80030-7.
- [1190] J.I. Lee, A.E. Mather, Excess enthalpy of gaseous mixtures of nitrogen and carbon dioxide, *J. Chem. Eng. Data* 17 (1972) 189–192, doi:10.1021/je60053a042.
- [1191] L.Q. Lobo, A.G.M. Ferreira, I.M.A. Fonseca, A.M.P. Senra, Vapour pressure and excess Gibbs free energy of binary mixtures of hydrogen sulphide with ethane, propane, and n-butane at temperature of 182.33K, *J. Chem. Thermodyn.* 38 (2006) 1651–1654, doi:10.1016/j.jct.2006.03.013.
- [1192] F.-Y. Jou, J.J. Carroll, A.E. Mather, Azeotropy and critical behavior in the system propane-hydrogen sulfide, *Fluid Phase Equilibria* 109 (1995) 235–244, doi:10.1016/0378-3812(95)02721-P.
- [1193] W.B. Kay, G.M. Ramesek, Liquid-Vapor Equilibrium Relations in Binary Systems - Propane - Hydrogen Sulfide System, *Ind. Eng. Chem.* 45 (1953) 221–226, doi:10.1021/ie50517a065.
- [1194] J. Brewer, N. Rodewald, F. Kurata, Phase equilibria of the propane-hydrogen sulfide system from the cricondotherm to the solid-liquid-vapor region, *AIChE J.* 7 (1961) 13–16, doi:10.1002/aic.690070105.
- [1195] E.R. Gilliland, H.W. Scheeline, High-Pressure Vapor-Liquid Equilibrium, *Ind. Eng. Chem.* 32 (1940) 48–54, doi:10.1021/ie50361a009.
- [1196] F. Steckel, Vapor-liquid equilibria under pressure of some binary hydrogen sulfide-containing systems, *Sven Kem Tidskr* 57 (1945) 209–216.
- [1197] M. Dicko, C. Coquelet, P. Theveneau, P. Mougou, Phase Equilibria of H<sub>2</sub>S-Hydrocarbons (Propane, n-Butane, and n-Pentane) Binary Systems at Low Temperatures, *J. Chem. Eng. Data* 57 (2012) 1534–1543, doi:10.1021/je300111m.
- [1198] A.D. Leu, D.B. Robinson, Equilibrium phase properties of the n-butane-hydrogen sulfide and isobutane-hydrogen sulfide binary systems, *J. Chem. Eng. Data* 34 (1989) 315–319, doi:10.1021/je00057a017.
- [1199] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. Volumetric and Phase Behavior of n-Pentane-Hydrogen Sulfide System, *Ind. Eng. Chem.* 45 (1953) 1805–1809, doi:10.1021/ie50524a054.
- [1200] S. Laugier, D. Richon, Vapor-Liquid Equilibria for Hydrogen Sulfide + Hexane, + Cyclohexane, + Benzene, + Pentadecane, and + (Hexane + Pentadecane), *J. Chem. Eng. Data* 40 (1995) 153–159, doi:10.1021/je00017a034.
- [1201] J.-Z. Yin, C.-S. Tan, Solubility of hydrogen in toluene for the ternary system H<sub>2</sub>+CO<sub>2</sub>+toluene from 305 to 343K and 1.2 to 10.5MPa, *Fluid Phase Equilibria* 242 (2006) 111–117, doi:10.1016/j.fluid.2006.01.013.
- [1202] J.J. Simnick, H.M. Sebastian, H.M. Lin, K.C. Chao, Gas-liquid equilibrium in mixtures of hydrogen + m-xylene and + m-cresol, *J. Chem. Thermodyn.* 11 (1979) 531–537, doi:10.1016/0021-9614(79)90091-0.
- [1203] L. Zhao, Y. Zhao, Z. Lu, Solubility of H<sub>2</sub> and CO in mixed xylene, *Huaxue Fanying Gongcheng Yu Gongyi* 16 (2000) 396–400.
- [1204] M. Herskowitz, J. Wisniak, L. Skladman, Hydrogen solubility in organic liquids, *J. Chem. Eng. Data* 28 (1983) 164–166, doi:10.1021/je00032a009.
- [1205] H.-S. Phiong, F.P. Lucien, Solubility of Hydrogen in  $\alpha$ -Methylstyrene and Cumene at Elevated Pressure, *J. Chem. Eng. Data* 47 (2002) 474–477, doi:10.1021/je015531x.
- [1206] J. Yao, H.M. Sebastian, H.M. Lin, K.C. Chao, Gas-liquid equilibria in mixtures of hydrogen and 1-methylnaphthalene, *Fluid Phase Equilibria* 1 (1977) 293–304, doi:10.1016/0378-3812(77)80012-5.
- [1207] H.M. Lin, H.M. Sebastian, K.C. Chao, Gas-liquid equilibria of hydrogen + 1-methylnaphthalene at 457°C, *Fluid Phase Equilibria* 4 (1980) 321, doi:10.1016/0378-3812(80)80035-5.
- [1208] S. Partzsch, Ph.D. Thesis, University of Leipzig, 1992.
- [1209] D. Zudkevitch, N. Weinstein, T. Daubert, Applicability of phase equilibrium data correlations to high temperature-high pressure aromatic systems and liquid fuels from coal, *Proc. Natl. Phys. Lab. Symp.* 87 (1978) 1–26.
- [1210] P.V. Malone, R. Kobayashi, Light gas solubility in phenanthrene: the hydrogen-phenanthrene and methane-phenanthrene systems, *Fluid Phase Equilibria* 55 (1990) 193–205, doi:10.1016/0378-3812(90)85012-Y.
- [1211] I. Krichevskii, G. Sorina, Phase and volume relations in liquid-gas systems at high pressures. VI. The cyclohexane-hydrogen system, *Zhurnal Fiz. Khimii* 32 (1958) 2080–2086.
- [1212] T.E. Berty, H.H. Reamer, B.H. Sage, Phase Behavior in the Hydrogen-Cyclohexane System, *J. Chem. Eng. Data* 11 (1966) 25–30, doi:10.1021/je60028a006.
- [1213] D. Ronze, P. Fongarland, I. Pitault, M. Forissier, Hydrogen solubility in straight run gasoil, *Chem. Eng. Sci.* 57 (2002) 547–553, doi:10.1016/S0009-2509(01)00404-3.
- [1214] R.H. Harrison, S.E. Scheppele, G.P. Sturm, P.L. Grizzle, Solubility of hydrogen in well-defined coal liquids, *J. Chem. Eng. Data* 30 (1985) 183–189, doi:10.1021/je00040a016.
- [1215] S. Sung, Ph.D. Thesis, Pittsburgh University, 1981.
- [1216] K. Wiegand, B. Strobel, H. Hofmann, Phase equilibria measurements between hydrocarbon liquids and hydrogen under high temperatures and high pressures, *Erdoel Kohle Erdgas Petrochem* 40 (1987) 216–221.
- [1217] H.-M. Lin, Y.-R. Lin, Flow apparatus for phase equilibrium measurement at elevated temperatures, *AIChE J.* 36 (1990) 1597–1600, doi:10.1002/aic.690361019.
- [1218] P. Nasir, R.J. Martin, R. Kobayashi, A novel apparatus for the measurement of the phase and volumetric behavior at high temperatures and pressures and its application to study VLE in the hydrogen-tetralin system, *Fluid Phase Equilibria* 5 (1981) 279–288, doi:10.1016/0378-3812(80)80061-6.
- [1219] H.M. Sebastian, J. Yao, H.-M. Lin, K.-C. Chao, Gas-liquid equilibrium of the hydrogen/bicyclohexyl system at elevated temperatures and pressures, *J. Chem. Eng. Data* 23 (1978) 167–170, doi:10.1021/je60077a013.
- [1220] C.Y. Tsang, W.B. Street, Phase equilibria in the H<sub>2</sub>/CO<sub>2</sub> system at temperatures from 220 to 290 K and pressures to 172 MPa, *Chem. Eng. Sci.* 36 (1981) 993–1000, doi:10.1016/0009-2509(81)80085-1.
- [1221] M. Yorizane, S. Yoshimura, H. Masuoka, Vapor liquid equilibrium at high pressures. N<sub>2</sub>-CO<sub>2</sub>, H<sub>2</sub>-CO<sub>2</sub> systems, *Kagaku Kagaku* 34 (1970) 953–957.
- [1222] P. Barrick, C. Heck, J. Spano, Liquid-vapor equilibria of the hydrogen-carbon dioxide system, *Air Force Mater. Lab.* 69 (1966) 66–390.
- [1223] J.O. Spano, C.K. Heck, P.L. Barrick, Liquid-vapor equilibria of the hydrogen-carbon dioxide system, *J. Chem. Eng. Data* 13 (1968) 168–171, doi:10.1021/je60037a007.
- [1224] G. Kaminishi, T. Toriumi, Gas-liquid equilibrium under high pressures. VI. Vapor-liquid phase equilibrium in the CO<sub>2</sub>-H<sub>2</sub>, CO<sub>2</sub>-N<sub>2</sub>, and CO<sub>2</sub>-O<sub>2</sub> systems, *Kogyo Kagaku Zasshi* 69 (1966) 175–178.
- [1225] K. Bezanek, G.B. Combes, F. Delghani, N.R. Foster, D.L. Tomasko, Vapor-Liquid Equilibrium for Binary Systems of Carbon Dioxide + Methanol, Hydrogen + Methanol, and Hydrogen + Carbon Dioxide at High Pressures, *J. Chem. Eng. Data* 47 (2002) 161–168, doi:10.1021/je010122m.
- [1226] W.B. Street, J.C.G. Calado, Liquid-vapour equilibrium for hydrogen + nitrogen at temperatures from 63 to 110 K and pressures to 57 MPa, *J. Chem. Thermodyn.* 10 (1978) 1089–1100, doi:10.1016/0021-9614(78)90083-6.
- [1227] T.T.H. Verschoyle, F.A. Freeth, The ternary system carbon monoxide-nitrogen-hydrogen and the component binary systems between temperatures of -185° and -215° C., and between pressures of 0 and 225 atm, *Philos. Trans. R. Soc. Lond. Ser. Contain. Pap. Math. Phys. Character.* 230 (1931) 189–220, doi:10.1098/rsta.1932.0006.
- [1228] F. Shtekkel, N. Tsin, Determination of the composition diagram for the liquid-gas system methane-nitrogen-hydrogen, *Zhurnal Khimicheskoi Promyshlennosti* 16 (1939) 24–28.
- [1229] L.S. Eubanks, Ph.D. Thesis, Houston University, 1957.
- [1230] W. Akers, L. Eubanks, Vapor-liquid equilibria in the system hydrogen-nitrogen-carbon monoxide, in: *Proc. Cryog. Eng. Conf. 2nd Boulder*, 1957, pp. 275–293.
- [1231] M. Gonikberg, V. Fastovskii, I. Gurvich, Solubility of gases in liquids at low temperatures and high pressures. I. Solubility of hydrogen in liquid nitrogen at temperatures from 79.0 to 109.0 °K. and at pressures up to 190 atmospheres, *Acta Physicochim. URSS.* 11 (1939) 865–882.
- [1232] J. Xiao, K. Liu, Y. Du, Z. Jin, H. Lu, Measurement on and correlation of VLE of H<sub>2</sub>-N<sub>2</sub>-Ar System, *Chem. Eng. China* 18 (1990) 8–12.
- [1233] M. Gonikberg, V. Fastovskii, I. Gurvich, The solubility of gases in liquids at low temperatures and high pressures, *Zhurnal Fiz. Khimii* 13 (1939) 1669–1679.
- [1234] A. Maimoni, Liquid-vapor equilibria in the hydrogen-nitrogen and deuterium-nitrogen systems, *AIChE J.* 7 (1961) 371–375, doi:10.1002/aic.690070306.



- [1235] M. Yorzane, S. Yoshimura, H. Masuoka, Measurement and prediction of the vapor-liquid equilibrium relation at low temperature and high pressure for the hydrogen-nitrogen system, *Kagaku Kogaku* 35 (1971) 691-693.
- [1236] H. Knapp, K. Schmölling, A. Neumann, Measurement of the molal heat capacity of H<sub>2</sub>-N<sub>2</sub> mixtures, *Cryogenics* 16 (1976) 231-237, doi:10.1016/0011-2275(76)90266-6.
- [1237] M.H. Omar, Z. Dokoupil, Some supplementary measurements on the vapour-liquid equilibrium of the system hydrogen-nitrogen at temperatures higher than the triple point of nitrogen, *Physica* 28 (1962) 33-43, doi:10.1016/0031-8914(62)90089-7.
- [1238] Z. Dokoupil, G. Van Soest, M. Swenker, The equilibrium between the solid phase and the gas phase of the systems hydrogen-nitrogen, hydrogen-carbon monoxide, and hydrogen-nitrogen-carbon monoxide, *Appl. Sci. Res. Sect. A* 5 (1955) 182-241.
- [1239] M. Knoester, K.W. Taconis, J.J.M. Beenakker, Excess enthalpies of gaseous mixtures of hydrogen, nitrogen and argon between 150 and 293°K and at pressures up to 130 ATM, *Physica* 33 (1967) 389-409, doi:10.1016/0031-8914(67)90172-3.
- [1240] M. Yorzane, S. Sadamoto, H. Masuoka, Solubility of gases in methanol at high pressures, *Kogyo Kagaku Zasshi* 72 (1969) 2174-2177.
- [1241] V. Maslennikova, N. Goryunova, L. Subbotina, The Solubility of Water in Compressed Hydrogen, *Russ. J. Phys. Chem.* 50 (1976) 240-243.
- [1242] G. Kling, G. Maurer, The solubility of hydrogen in water and in 2-aminoethanol at temperatures between 323 K and 423 K and pressures up to 16 MPa, *J. Chem. Thermodyn.* 23 (1991) 531-541, doi:10.1016/S0021-9614(05)80095-3.
- [1243] V. Ipat'ev, V. Teodorovich, Solubility of hydrogen in water under pressure at elevated temperatures, *Zh. Obshch. Khim.* 4 (1934) 395-399.
- [1244] R. Wiebe, V.L. Gaddy, The Solubility of Hydrogen in Water at 0, 50, 75 and 100° from 25 to 1000 Atmospheres, *J. Am. Chem. Soc.* 56 (1934) 76-79, doi:10.1021/ja01316a022.
- [1245] L. Zoss, Ph.D. thesis, Purdue University, West Lafayette, IN, 1952, pp. 1-76.
- [1246] J. Alvarez, R. Crovetto, R. Fernández-Prini, The Dissolution of N<sub>2</sub> and of H<sub>2</sub> in Water from Room Temperature to 640 K, *Berichte Bunsenges. Für Phys. Chem.* 92 (1988) 935-940, doi:10.1002/bbpc.198800223.
- [1247] Z. Chen, Z. Yao, F. Zhu, K. Cao, Y. Li, Z. Huang, Gas-Liquid Critical Properties of Ethylene + Hydrogen and Propylene + Hydrogen Binary Mixtures, *J. Chem. Eng. Data* 55 (2010) 2004-2007, doi:10.1021/je9009199.
- [1248] A. Heintz, W.B. Streett, Phase Equilibria in the H<sub>2</sub>/C<sub>2</sub>H<sub>4</sub> System at Temperatures from 114.1 to 247.1 K and Pressures to 600 MPa, *Berichte Bunsenges. Für Phys. Chem.* 87 (1983) 298-303, doi:10.1002/bbpc.19830870406.
- [1249] M. Hiza, C. Heck, A. Kidnay, *Chem. Eng. Progr. Symp. Ser.* 64 (1968) 57-65.
- [1250] A. Likhter, N. Tikhonovich, *Zh. Tekh. Fiz.* 9 (1939) 1916-1922.
- [1251] H. Sagara, S. Mihara, Y. Arai, S. Saito, Vapor-Liquid Equilibria and Henry's Con-Stants for Ternary Systems Containing Hydrogen and Light Hydrocarbons, *J. Chem. Eng. Jpn.* 8 (1975) 98-104, doi:10.1252/jcej.8.98.
- [1252] I. Vasil'eva, A. Naumova, A. Polyakov, *J. Appl. Chem. USSR* 59 (1986) 1180-1183.
- [1253] M. Herskowitz, S. Morita, J.M. Smith, Solubility of hydrogen in  $\alpha$ -methylstyrene, *J. Chem. Eng. Data* 23 (1978) 227-228, doi:10.1021/je60078a010.
- [1254] D. Ramjugernath, A. Valtz, C. Coquelet, D. Richon, Isothermal Vapor-Liquid Equilibrium Data for the Hexafluoroethane (R116) + Propane System at Temperatures from (263 to 323) K, *J. Chem. Eng. Data* 54 (2009) 1292-1296, doi:10.1021/je800849s.
- [1255] D. Ramjugernath, A. Valtz, D. Richon, M.D. Williams-Wynn, C. Coquelet, Isothermal Vapor-Liquid Equilibrium Data for the Hexafluoroethane (R116) + n-Butane System at Temperatures from 273 to 323 K, *J. Chem. Eng. Data* 62 (2017) 3483-3487, doi:10.1021/acs.jced.7b00485.
- [1256] D. Ramjugernath, A. Valtz, D. Richon, M.D. Williams-Wynn, C. Coquelet, Isothermal Vapor-Liquid Equilibrium Data for Binary Mixtures of Hexafluoroethane (R116) + n-Pentane or n-Hexane at Two Temperatures, 288 and 296 K, *J. Chem. Eng. Data* 63 (2018) 1228-1233, doi:10.1021/acs.jced.7b00836.
- [1257] Y. Zhang, Gong, Zhu, Wu, Vapor-Liquid Equilibrium Measurements for the Ethane + Hexafluoroethane System over a Temperature Range from (199.64 to 242.93) K, *J. Chem. Eng. Data* 50 (2005) 2074-2076, doi:10.1021/je050281w.
- [1258] Y. Zhang, M.-Q. Gong, H.-B. Zhu, J.-F. Wu, Vapor-liquid equilibrium measurements and correlations for an azeotropic system of ethane+hexafluoroethane, *Fluid Phase Equilibria* 240 (2006) 73-78, doi:10.1016/j.fluid.2005.12.004.
- [1259] D. Ramjugernath, C. Coquelet, A. Valtz, D. Richon, Vapor-Liquid Equilibria For Binary Systems Consisting Of Hexafluoroethane (R116) With Ethane And Propane, in: 2007 Annu. Meet., 2007 n.d.
- [1260] A. Valtz, C. Coquelet, D. Richon, Vapor-liquid equilibrium data for the hexafluoroethane+carbon dioxide system at temperatures from 253 to 297K and pressures up to 6.5MPa, *Fluid Phase Equilibria* 258 (2007) 179-185, doi:10.1016/j.fluid.2007.06.012.
- [1261] G. Di Nicola, F. Polonara, R. Ricci, R. Stryjek, PVTx Measurements for the R116 + CO<sub>2</sub> and R41 + CO<sub>2</sub> Systems. New Isochoric Apparatus, *J. Chem. Eng. Data* 50 (2005) 312-318, doi:10.1021/je049939g.
- [1262] M.B. Shiflett, S.I. Sandler, Modeling fluorocarbon vapor-liquid equilibria using the Wong-Sandler model, *Fluid Phase Equilibria* 147 (1998) 145-162, doi:10.1016/S0378-3812(98)00253-2.
- [1263] M.B. Shiflett, A. Yokozeki, B.H. Minor, Azeotropic compositions of perfluoroethane and trifluoromethane, EP0649453B1, 1997. <https://patents.google.com/patent/EP0649453B1/en?q=EP0649453B1> (accessed August 8, 2021).
- [1264] M. Kleiber, Vapor-liquid equilibria of binary refrigerant mixtures containing propylene or R134a, *Fluid Phase Equilibria* 92 (1994) 149-194, doi:10.1016/0378-3812(94)80046-4.
- [1265] A.E.H.N. Mousa, W.B. Kay, A. Kreglewski, The critical constants of binary mixtures of certain perfluoro-compounds with alkanes, *J. Chem. Thermodyn.* 4 (1972) 301-311, doi:10.1016/0021-9614(72)90069-9.
- [1266] J.B. Gilmour, J.O. Zwicker, J. Katz, R.L. Scott, Fluorocarbon solutions at low temperatures. V. The liquid mixtures C<sub>2</sub>H<sub>6</sub>+C<sub>2</sub>F<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>+C<sub>2</sub>F<sub>6</sub>, CH<sub>4</sub>+C<sub>3</sub>F<sub>8</sub>, C<sub>2</sub>H<sub>6</sub>+C<sub>3</sub>F<sub>8</sub>, C<sub>3</sub>H<sub>8</sub>+C<sub>3</sub>F<sub>8</sub>, C<sub>4</sub>C<sub>10</sub>+C<sub>3</sub>F<sub>8</sub>, iso-C<sub>4</sub>H<sub>10</sub>+C<sub>3</sub>F<sub>8</sub>, C<sub>3</sub>H<sub>8</sub>+C<sub>4</sub>F<sub>10</sub>, n-C<sub>6</sub>H<sub>14</sub>+C<sub>4</sub>F<sub>10</sub>, n-C<sub>7</sub>H<sub>16</sub>+C<sub>4</sub>F<sub>10</sub>, n-C<sub>8</sub>H<sub>18</sub>+n-C<sub>4</sub>F<sub>10</sub>, and n-C<sub>10</sub>H<sub>22</sub>+n-C<sub>4</sub>F<sub>10</sub>, *J. Phys. Chem.* 71 (1967) 3259-3270, doi:10.1021/j100869a021.
- [1267] Bobbo Sergio, Camporese Roberto, R. Stryjek, Vapor + liquid ) equilibrium measurement and correlation of the refrigerant ( propane + 1,1,1,3,3,3-hexafluoropropane) at T = ( 283.13, 303.19, and 323.26) K, *J. Chem. Thermodyn.* 32 (2000) 1647-1656, doi:10.1006/jcht.2000.0713.
- [1268] C. Coquelet, Private communication (2022).
- [1269] J.W. Mausteller, PhD Thesis, The Pennsylvania State University, 1951.
- [1270] J. Aftienjew, A. Zawisza, High-pressure liquid-vapour equilibria, critical state, and p(V, T, x) up to 501.15 K and 4.560 MPa for n-pentane + n-perfluoropentane, *J. Chem. Thermodyn.* 9 (1977) 153-165, doi:10.1016/0021-9614(77)90081-7.
- [1271] J.H. Simons, R.D. Dunlap, The Properties of n-Pentane and Its Mixtures with n-Pentane, *J. Chem. Phys.* 18 (1950) 335-346, doi:10.1063/1.1747628.
- [1272] R.D. Dunlap, R.G. Bedford, J.C. Woodbrey, S.D. Furrow, Liquid-Vapor Equilibrium for the System: Perfluoro-n-hexane-n-Hexane1, *J. Am. Chem. Soc.* 81 (1959) 2927-2930, doi:10.1021/ja01521a002.
- [1273] L.W. Jordan, W.B. Kay, Phase relations of binary systems that form azeotropes: N-alkanes - Perfluoro-n-heptane systems (ethane through n-nonane), *Chem Eng Prog Symp Ser* 59 (1963) 46-51.
- [1274] J.A. Neff, J.B. Hickman, Total Pressure over Certain Binary Liquid Mixtures, *J. Phys. Chem.* 59 (1955) 42-45, doi:10.1021/j150523a013.
- [1275] M. Aleksееva, N. Smirnova, N. Sokolovskaya, Phase-equilibrium in systems containing perfluoroalkane. 7. Liquid-liquid-vapor equilibrium in alkane-alkane-perfluoroalkane ternary-systems, *J. Appl. Chem. URSS* 58 (1985) 1232-1236.
- [1276] S. Bobbo, R. Stryjek, N. Elvassore, A. Bertucco, A recirculation apparatus for vapor-liquid equilibrium measurements of refrigerants. Binary mixtures of R600a, R134a and R236fa, *Fluid Phase Equilibria* 150-151 (1998) 343-352, doi:10.1016/S0378-3812(98)00334-3.
- [1277] C.R. Mueller, J.E. Lewis, Thermodynamic and Transport Properties of the System Iso-Octane and Perfluoroheptane, *J. Chem. Phys.* 26 (1957) 286-292, doi:10.1063/1.1743286.
- [1278] E.E. Ahmar, A. Valtz, P. Naidoo, C. Coquelet, D. Ramjugernath, Isothermal Vapor-Liquid Equilibrium Data for the Perfluorobutane (R610) + Ethane System at Temperatures from (263 to 353) K, *J. Chem. Eng. Data* 56 (2011) 1918-1924, doi:10.1021/je1009398.
- [1279] R. Jadot, M. Fraiha, Isobaric vapor-liquid equilibrium of (trifluoromethyl)benzene with benzene, toluene, or chlorobenzene, *J. Chem. Eng. Data* 37 (1992) 509-511, doi:10.1021/je00008a031.
- [1280] S. Kramp, H.G. Wagner, A. Sander, Die dampf/flüssigkeitsgleichgewichte von binären systemen aus fluorierten kohlenwasserstoffen und kohlenwasserstoffen, *Chem. Ing. Tech.* 61 (1989) 664-665, doi:10.1002/cite.330610832.
- [1281] F.D. Evans, R. Battino, The solubility of gases in liquids 3. The solubilities of gases in hexafluorobenzene and in benzene, *J. Chem. Thermodyn.* 3 (1971) 753-760, doi:10.1016/S0021-9614(71)80003-4.
- [1282] B.H. Minor, 1,1,2,2,3,3,4,4-octafluorobutane compositions, WO1997039081A1, 1997. <https://patents.google.com/patent/WO1997039081A1/en?q=WO1997039081A1> (accessed August 8, 2021).
- [1283] A. Valtz, X. Courtial, E. Johansson, C. Coquelet, D. Ramjugernath, Isothermal vapor-liquid equilibrium data for the carbon dioxide (R744)-decafluorobutane (R610) system at temperatures from 263 to 353K, *Fluid Phase Equilibria* 304 (2011) 44-51, doi:10.1016/j.fluid.2011.01.017.
- [1284] Y.W. Kho, D.C. Conrad, B.L. Knutson, Phase equilibria and thermophysical properties of carbon dioxide-expanded fluorinated solvents, *Fluid Phase Equilibria* 206 (2003) 179-193, doi:10.1016/S0378-3812(02)00316-3.
- [1285] A.M.A. Dias, H. Carrier, J.L. Daridon, J.C. Pàmies, L.F. Vega, J.A.P. Coutinho, I.M. Marrucho, Vapor-Liquid Equilibrium of Carbon Dioxide-Perfluoroalkane Mixtures: Experimental Data and SAFT Modeling, *Ind. Eng. Chem. Res.* 45 (2006) 2341-2350, doi:10.1021/ie051017z.
- [1286] V.S. Zernov, V.B. Kogan, S.G. Lyubetskii, F.I. Duntov, *J. Appl. Chem. USSR* 44 (1971) 693-696.
- [1287] V.S. Zernov, V.B. Kogan, S.G. Lyubetskii, F.I. Duntov, *J. Appl. Chem. USSR* 44 (1971) 683-686.
- [1288] S.C. Subramoney, X. Courtial, P. Naidoo, C. Coquelet, D. Richon, D. Ramjugernath, Isothermal vapor-liquid equilibrium data for the ethylene+1,1,2,3,3,3-hexafluoro-1-propene binary system between 258 and 308K at pressures up to 4.56MPa, *Fluid Phase Equilibria* 353 (2013) 7-14, doi:10.1016/j.fluid.2013.05.018.
- [1289] S.C. Subramoney, P. Naidoo, A. Valtz, C. Coquelet, D. Richon, D. Ramjugernath, Experimental (vapour+liquid) equilibrium data and modelling for binary mixtures of decafluorobutane with propane and 1-butene, *J. Chem. Thermodyn.* 67 (2013) 134-142, doi:10.1016/j.jct.2013.07.020.
- [1290] S.C. Subramoney, A. Valtz, C. Coquelet, D. Richon, P. Naidoo, D. Ramjuger-

- nath, Vapor-liquid equilibrium measurements and modeling for the ethane (R-170) + 1,1,2,3,3,3-Hexafluoro-1-propene (R-1216) Binary System, *J. Chem. Eng. Data*. 57 (2012) 2947–2955, doi:10.1021/jc300431n.
- [1291] S.C. Subramoney, W.M. Nelson, A. Valtz, C. Coquelet, D. Richon, P. Naidoo, D. Ramjugernath, Pure component and binary vapor-liquid equilibrium + modeling for hexafluoropropylene and hexafluoropropylene oxide with toluene and hexafluoroethane, *J. Chem. Eng. Data*. 55 (2010) 411–418, doi:10.1021/jc900400v.
- [1292] W.M. Nelson, S.C. Subramoney, A. Valtz, C. Coquelet, D. Richon, P. Naidoo, D. Ramjugernath, Vapor-liquid equilibrium data for binary systems consisting of either hexafluoropropene (hfp) or 2,2,3-trifluoro-3-(trifluoromethyl)oxirane (HFPO) with carbon dioxide (R-744) or 2,2-Dichloro-1,1,1-trifluoroethane (R-123), *J. Chem. Eng. Data*. 56 (2011) 74–78, doi:10.1021/jc100841y.
- [1293] C. Coquelet, A. Valtz, P. Naidoo, D. Ramjugernath, D. Richon, Isothermal Vapor-Liquid Equilibrium Data for the Hexafluoropropylene (R1216) + Propylene System at Temperatures from (263.17 to 353.14) K, *J. Chem. Eng. Data*. 55 (2010) 1636–1639, doi:10.1021/jc900703f.
- [1294] J. Storm, Ph.D. Thesis, TU Braunschweig, 1989.
- [1295] E. Fransson, A. Barreau, J. Vidal, Vapor-liquid equilibrium in binary systems of n-pentane + chlorodifluoromethane or + 1,1-difluoroethane, *J. Chem. Eng. Data*. 37 (1992) 521–525, doi:10.1021/jc00008a034.
- [1296] J.S. Lim, J.-Y. Park, B.-G. Lee, Y.-W. Lee, J.-D. Kim, Phase Equilibria of CFC Alternative Refrigerant Mixtures: Binary Systems of Isobutane + 1,1,1,2-Tetrafluoroethane, + 1,1-Difluoroethane, and + Difluoromethane, *J. Chem. Eng. Data*. 44 (1999) 1226–1230, doi:10.1021/jc9900777.
- [1297] B. Bian, Ph.D. thesis, University of Nanjing, 1992.
- [1298] K. Ohgaki, M. Kageyama, T. Katayama, *J. Chem. Eng. Jpn.* 23 (1990) 763–764.
- [1299] A.P. Kuznetsov, I.V. Volobuev, V.I. Los, M.G. Khmel'nyuk, Study of phase equilibrium of a mixture of R152A-R218 refrigerants, *Kholod Tekhn Tekhnol* 34 (1982) 93–96.
- [1300] I.V. Volobuev, M.G. Khmel'nyuk, P.S. Bolkhovskii, Thermodynamic properties of a R-152A-R-218 mixture, *Kholod Tekhn Tekhnol* 39 (1984) 68–71.
- [1301] F. Ampueda, Ph.D. Thesis, Universitè de Lyon, Lyon, France, 1986.
- [1302] A. Henni, S. Jaffer, A.E. Mather, Solubility of N<sub>2</sub>O and CO<sub>2</sub> in n-Dodecane, *Can. J. Chem. Eng.* 74 (1996) 554–557, doi:10.1002/cjce.5450740418.
- [1303] I. Nieuwoudt, M. du Rand, Measurement of phase equilibria of supercritical carbon dioxide and paraffins, *J. Supercrit. Fluids*. 22 (2002) 185–199, doi:10.1016/S0896-8446(01)00122-X.
- [1304] H. Gardeler, J. Gmehlin, Experimental determination of phase equilibria and comprehensive examination of the predictive capabilities of group contribution equations of state with a view to the synthesis of supercritical extraction processes, *Supercrit. Fluids Solvents React. Media*. (2004) 3–38, doi:10.1016/b978-044451574-2/50001-8.
- [1305] R. Enick, G. Holder, B. Morsi, Critical and three phase behavior in the carbon dioxide/tridecane system, *Fluid Phase Equilibria* 22 (1985) 209–224.
- [1306] D.J. Fall, K.D. Luks, Liquid-liquid-vapor phase equilibria of the binary system carbon dioxide + n-tridecane, *J. Chem. Eng. Data*. 30 (1985) 276–279, doi:10.1021/jc00041a012.
- [1307] M. Kato, K. Aizawa, T. Kanahira, A new experimental method for measuring gas solubilities in nonvolatile liquid mixtures, *Sekiyu Gakkaishi* 35 (1992) 318–323.
- [1308] J. van der Steen, Th.W. de Loos, J. de Swaan Arons, The volumetric analysis and prediction of liquid-liquid-vapor equilibria in certain carbon dioxide + n-alkane systems, *Fluid Phase Equilibria* 51 (1989) 353–367, doi:10.1016/0378-3812(89)80376-0.
- [1309] A. Danesh, A.C. Todd, J. Somerville, A. Dandekar, Direct measurement of interfacial tension, density, volume, and compositions of gas-condensate system, *Chem. Eng. Res. Des.* 68 (1990) 325–330.
- [1310] K.A.M. Gasem, K.B. Dickson, P.B. Dulcamara, N. Nagarajan, R.L. Robinson, Equilibrium phase compositions, phase densities, and interfacial tensions for carbon dioxide + hydrocarbon systems. 5. Carbon dioxide + n-tetradecane, *J. Chem. Eng. Data*. 34 (1989) 191–195, doi:10.1021/jc00056a013.
- [1311] S. Laugier, D. Richon, H. Renon, Simultaneous determination of vapor-liquid equilibria and volumetric properties of ternary systems with a new experimental apparatus, *Fluid Phase Equilibria* 54 (1990) 19–34, doi:10.1016/0378-3812(90)85067-K.
- [1312] L.-S. Wang, Z.-X. Lang, T.-M. Guo, Measurement and correlation of the diffusion coefficients of carbon dioxide in liquid hydrocarbons under elevated pressures, *Fluid Phase Equilibria* 117 (1996) 364–372, doi:10.1016/0378-3812(95)02973-7.
- [1313] A. Scheidgen, Diploma Thesis, Ruhr-Universität Bochum, 1994.
- [1314] H. Tanaka, Y. Yamaki, M. Kato, Solubility of carbon dioxide in pentadecane, hexadecane, and pentadecane + hexadecane, *J. Chem. Eng. Data*. 38 (1993) 386–388, doi:10.1021/jc00011a013.
- [1315] A. Pöhler, Doctoral Thesis, Ruhr-Universität Bochum, 1994.
- [1316] A. Scheidgen, Doctoral Thesis, Ruhr-Universität Bochum, 1997.
- [1317] M.B. King, K. Kassim, T.R. Bott, J.R. Sheldon, R.S. Mahmud, Prediction of mutual solubilities of heavy components with super-critical and slightly sub-critical solvents: the role of equations of state and some applications of a simple expanded lattice model at subcritical temperatures, *Berichte Bunsenges. Für Phys. Chem.* 88 (1984) 812–820, doi:10.1002/bbpc.1984088090.
- [1318] A. Meldrum, R. Nielsen, Three-phase equilibria for carbon dioxide-hydrocarbon mixtures, *Prod Mon* 16 (1955) 22–35.
- [1319] T. Charoensombut-amon, R.J. Martin, R. Kobayashi, Application of a generalized multiproperty apparatus to measure phase equilibrium and vapor phase densities of supercritical carbon dioxide in n-hexadecane systems up to 26 MPa, *Fluid Phase Equilibria* 31 (1986) 89–104, doi:10.1016/S0378-3812(86)87033-9.
- [1320] R. D'souza, J.R. Patrick, A.S. Teja, High pressure phase equilibria in the carbon dioxide - n-Hexadecane and carbon dioxide - water systems, *Can. J. Chem. Eng.* 66 (1988) 319–323, doi:10.1002/cjce.5450660221.
- [1321] G. Brunner, J. Teich, R. Dohrn, Phase equilibria in systems containing hydrogen, carbon dioxide, water and hydrocarbons, *Fluid Phase Equilibria* 100 (1994) 253–268, doi:10.1016/0378-3812(94)80013-8.
- [1322] A. Kordikowski, G.M. Schneider, Fluid phase equilibria of binary and ternary mixtures of supercritical carbon dioxide with low-volatility organic substances up to 100 MPa and 393 K, *Fluid Phase Equilibria* 90 (1993) 149–162, doi:10.1016/0378-3812(93)85010-J.
- [1323] M. Spee, G.M. Schneider, Fluid phase equilibrium studies on binary and ternary mixtures of carbon dioxide with hexadecane, 1-dodecanol, 1,8-octanediol and dotriacontane at 393.2 K and at pressures up to 100 MPa, *Fluid Phase Equilibria* 65 (1991) 263–274, doi:10.1016/0378-3812(91)87029-9.
- [1324] B.B. Breman, A.A.C.M. Beenackers, E.W.J. Rietjens, R.J.H. Stege, Gas-liquid solubilities of carbon monoxide, carbon dioxide, hydrogen, water, 1-alcohols (1 .ltoreq. n .ltoreq. 6), and n-paraffins (2 .ltoreq. n .ltoreq. 6) in hexadecane, octacosane, 1-hexadecanol, phenanthrene, and tetraethylene glycol at pressures up to 5.5 mpa and temperatures from 293 to 553 K, *J. Chem. Eng. Data*. 39 (1994) 647–666, doi:10.1021/jc00016a004.
- [1325] H. Kim, H. Lin, K. Chao, Vapor-liquid equilibrium in binary mixtures of carbon dioxide + n-propylcyclohexane and carbon dioxide + n-octadecane, *AIChE Symp. Ser.* 81 (1985) 96–101.
- [1326] K. Ohgaki, I. Tsukahara, T. Katayama, High-pressure phase equilibria for octadecane-carbon dioxide and octadecane-ethane systems at 25 °C and 40 °C, *Kagaku Kagaku Rombunshu* 10 (1984) 372–376.
- [1327] S. Takishima, S. Hiraoka, Proc. 8th Int. Conf. Prop. Phase Equil. Prod. Proc. Des. (1998).
- [1328] D.J. Fall, J.L. Fall, K.D. Luks, Liquid-liquid-vapor immiscibility limits in carbon dioxide + n-paraffin mixtures, *J. Chem. Eng. Data*. 30 (1985) 82–88, doi:10.1021/jc00039a028.
- [1329] M.M. Elbaccouch, V.I. Bondar, R.G. Carbonell, C.S. Grant, Phase Equilibrium Behavior of the Binary Systems CO<sub>2</sub> + Nonadecane and CO<sub>2</sub> + Soysolv and the Ternary System CO<sub>2</sub> + Soysolv + Quaternary Ammonium Chloride Surfactant, *J. Chem. Eng. Data*. 48 (2003) 1401–1406, doi:10.1021/jc020201d.
- [1330] Y. Sato, Y. Tagashira, D. Maruyama, S. Takishima, H. Masuoka, Solubility of carbon dioxide in eicosane, docosane, tetracosane, and octacosane at temperatures from 323 to 473 K and pressures up to 40 MPa, *Fluid Phase Equilibria* 147 (1998) 181–193, doi:10.1016/S0378-3812(98)00250-7.
- [1331] K. Kato, K. Nagahama, M. Hirata, Generalized interaction parameters for the Peng-Robinson equation of state: carbon dioxide-n-paraffin binary systems, *Fluid Phase Equilibria* 7 (1981) 219–231, doi:10.1016/0378-3812(81)80009-X.
- [1332] G.X. Feng, A.E. Mather, Solubility of hydrogen sulfide in n-eicosane at elevated pressure, *J. Chem. Eng. Data*. 37 (1992) 412–413, doi:10.1021/jc00008a009.
- [1333] N.C. Huie, K.D. Luks, J.P. Kohn, Phase-equilibria behavior of systems carbon dioxide-n-eicosane and carbon dioxide-n-decane-n-eicosane, *J. Chem. Eng. Data*. 18 (1973) 311–313, doi:10.1021/jc60058a008.
- [1334] B.J. Schwarz, J.M. Prausnitz, Solubilities of methane, ethane, and carbon dioxide in heavy fossil-fuel fractions, *Ind. Eng. Chem. Res.* 26 (1987) 2360–2366, doi:10.1021/ie00071a031.
- [1335] G.J. Besserer, D.B. Robinson, Equilibrium-phase properties of isobutane-carbon dioxide system, *J. Chem. Eng. Data*. 18 (1973) 298–301, doi:10.1021/jc60058a010.
- [1336] K. Stead, J.M. Williams, Apparatus for studying phase equilibria phase equilibria of (carbon dioxide + 2,2-dimethylpropane) in the temperature range 220 to 300 K and at pressures up to 6.7 MPa, *J. Chem. Thermodyn.* 12 (1980) 265–275, doi:10.1016/0021-9614(80)90046-4.
- [1337] W. Tolley, Ph.D. Dissertation, Brigham Young University, 1990.
- [1338] N.N. Shah, M.E. Pozo de Fernandez, J.A. Zollweg, W.B. Streett, Vapor-liquid equilibrium in the system carbon dioxide + 2,2-dimethylpropane from 262 to 424 K at pressures to 8.4 MPa, *J. Chem. Eng. Data*. 35 (1990) 278–283, doi:10.1021/jc00061a015.
- [1339] R.L. Rowley, J.L. Oscarson, N.F. Giles, W.K. Tolley, R.M. Izatt, Experimental and molecular-dynamics simulated excess enthalpies and solubilities of neopentane in supercritical carbon dioxide, *Fluid Phase Equilibria* 60 (1990) 143–156, doi:10.1016/0378-3812(90)85048-F.
- [1340] G.J. Besserer, D.B. Robinson, Equilibrium-phase properties of isopentane-carbon dioxide system, *J. Chem. Eng. Data*. 20 (1975) 93–96, doi:10.1021/jc60064a011.
- [1341] B. Bian, Y. Wang, J. Shi, E. Zhao, B.C.-Y. Lu, Simultaneous determination of vapor-liquid equilibrium and molar volumes for coexisting phases up to the critical temperature with a static method, *Fluid Phase Equilibria* 90 (1993) 177–187, doi:10.1016/0378-3812(93)85012-B.
- [1342] F. Fontalba, D. Richon, H. Renon, Simultaneous determination of vapor-liquid equilibria and saturated densities up to 45 MPa and 433 K, *Rev. Sci. Instrum.* 55 (1984) 944–951, doi:10.1063/1.1137870.
- [1343] H. Cheng, J.A. Zollweg, W.B. Streett, Hua Hsueh K. Yeh Yu K. Cheng. 7 (1992) 157.
- [1344] H. Hiraoka, J.H. Hildebrand, The Solubility and Entropy of Solution of Certain

- Gases in (C4F9)3N, CCl2F•CClF2, and 2,2,4-(CH3)3C5H9, *J. Phys. Chem.* 68 (1964) 213–214, doi:10.1021/j100783a509.
- [1345] J.M. Prausnitz, P.R. Benson, Solubility of liquids in compressed hydrogen, nitrogen, and carbon dioxide, *AIChE J.* 5 (1959) 161–164, doi:10.1002/aic.690050208.
- [1346] V. Devlikamov, L. Semenova, N. Repin, Liquid–gas phase equilibria in the methane–carbon dioxide system, *Izv Vyss Uchebn Zaved Neft Gaz* 25 (1982) 42–46.
- [1347] G. Wilson, J. Peterson, Enthalpy and phase boundary measurements on carbon dioxide and mixtures of carbon dioxide with methane, ethane and hydrogen sulfide, *Gas Process. Assoc. Res. Rep.* RR- 12. (1975).
- [1348] B. Bian, Ph.D. Dissertation, University of Nanjing, 1992.
- [1349] T. Toriumi, G. Kaminishi, Vapor–liquid equilibria in the systems: carbon dioxide–carbon monoxide, carbon dioxide–carbon monoxide–hydrogen, carbon dioxide–methane, *Kenkyu Hokoku - Asahi Garasu Kogyo Gijutsu Shoreikai* 14 (1968) 67–79.
- [1350] S.-C. Hwang, H.-M. Lin, P.S. Chappellear, R. Kobayashi, Dew point study in the vapor–liquid region of the methane–carbon dioxide system, *J. Chem. Eng. Data.* 21 (1976) 493–497, doi:10.1021/jc60071a019.
- [1351] Fred. Kurata, K.Un. Im, Phase equilibrium of carbon dioxide and light paraffins in presence of solid carbon dioxide, *J. Chem. Eng. Data.* 16 (1971) 295–299, doi:10.1021/jc60050a018.
- [1352] H. Knapp, X. Yang, Z. Zhang, Vapor–liquid equilibria in ternary mixtures containing nitrogen, methane, ethane and carbon dioxide at low temperatures and high pressures, *Fluid Phase Equilibria* 54 (1990) 1–18, doi:10.1016/0378-3812(90)85066-J.
- [1353] G.-I. Kaminishi, Y. Arai, S. Saito, S. Maeda, Vapor-Liquid Equilibria for Binary and Ternary Systems Containing Carbon Dioxide, *J. Chem. Eng. Jpn.* 1 (1968) 109–116, doi:10.1252/jcej.1.109.
- [1354] H.G. Donnelly, D.L. Katz, Phase Equilibria in the Carbon Dioxide–Methane System, *Ind. Eng. Chem.* 46 (1954) 511–517, doi:10.1021/ie50531a036.
- [1355] F.A. Somait, A.J. Kidnay, Liquid–vapor equilibria at 270.00 K for systems containing nitrogen, methane, and carbon dioxide, *J. Chem. Eng. Data.* 23 (1978) 301–305, doi:10.1021/jc60079a019.
- [1356] S.C. Mraw, S.-C. Hwang, R. Kobayashi, Vapor–liquid equilibrium of the methane–carbon dioxide system at low temperatures, *J. Chem. Eng. Data.* 23 (1978) 135–139, doi:10.1021/jc60077a014.
- [1357] Y. Arai, G.-I. Kaminishi, S. Saito, The Experimental Determination of the P-V-T-X Relations for the Carbon Dioxide–Nitrogen and the Carbon Dioxide–Methane Systems, *J. Chem. Eng. Jpn.* 4 (1971) 113–122, doi:10.1252/jcej.4.113.
- [1358] T.A. Al-Sahhaf, A.J. Kidnay, E.D. Sloan, Liquid + vapor equilibria in the nitrogen + carbon dioxide + methane system, *Ind. Eng. Chem. Fundam.* 22 (1983) 372–380, doi:10.1021/i100012a004.
- [1359] N. Xu, J. Dong, Y. Wang, J. Shi, High pressure vapor liquid equilibria at 293 K for systems containing nitrogen, methane and carbon dioxide, *Fluid Phase Equilibria* 81 (1992) 175–186, doi:10.1016/0378-3812(92)85150-7.
- [1360] N. Xu, J. Dong, Y. Wang, Vapor–liquid equilibria for nitrogen–methane–carbon dioxide system near critical region, *Huagong Xuebao Chin Ed* 43 (1992) 640–644.
- [1361] A. Neumann, W. Walch, Dampf/Flüssigkeits-Gleichgewicht CO<sub>2</sub>/CH<sub>4</sub> im Bereich tiefer Temperaturen und kleiner CO<sub>2</sub>-Molenbrüche, *Chem. Ing. Tech.* 40 (1968) 241–244, doi:10.1002/cite.330400509.
- [1362] A.O. Barry, S.C. Kallaguine, R.S. Ramalho, Direct determination of enthalpy of mixing for the binary gaseous system methane–carbon dioxide by an isothermal flow calorimeter, *J. Chem. Eng. Data.* 27 (1982) 258–264, doi:10.1021/jc60029a010.
- [1363] J.I. Lee, A.E. Mather, The excess enthalpy of gaseous mixtures of carbon dioxide with methane, *Can. J. Chem. Eng.* 50 (1972) 95–100, doi:10.1002/cjce.5450500117.
- [1364] S. Horstmann, K. Fischer, J. Gmehling, P. Kolář, Experimental determination of the critical line for (carbon dioxide + ethane) and calculation of various thermodynamic properties for (carbon dioxide + n-alkane) using the PRRK model, *J. Chem. Thermodyn.* 32 (2000) 451–464, doi:10.1006/jcht.2000.0611.
- [1365] N. Khazanova, L. Lesnevskaya, A. Zakharova, Liquid–vapor equilibrium in the ethane–CO<sub>2</sub> system, *Khim Prom*, 1966, pp. 364–365.
- [1366] A. Fredenslund, J. Mollerup, Measurement and prediction of equilibrium ratios for the C<sub>2</sub>H<sub>6</sub>+ CO<sub>2</sub> system, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases.* 70 (1974) 1653–1660, doi:10.1039/F1974001653.
- [1367] S.E.M. Hamam, B.C.Y. Lu, Vapor–liquid equilibrium in the ethane–carbon dioxide system, *Can. J. Chem. Eng.* 52 (1974) 283–286, doi:10.1002/cjce.5450520226.
- [1368] D. Robinson, H. Kalra, Phase behavior selected hydrocarbon–non hydrocarbon systems, in: *Gas Processors Association, Proc. 53rd Annu. Conv.*, 1974, pp. 14–20.
- [1369] R.J. Gugnoni, J.W. Eldridge, V.C. Okay, T.J. Lee, Carbon dioxide–ethane phase equilibrium and densities from experimental measurements and the B-W-R equation, *AIChE J* 20 (1974) 357–362, doi:10.1002/aic.690200223.
- [1370] T.S. Brown, A.J. Kidnay, E.D. Sloan, Vapor–liquid equilibrium in the carbon dioxide–ethane system, *Fluid Phase Equilibria* 40 (1988) 169–184, doi:10.1016/0378-3812(88)80028-1.
- [1371] D.J.P. Kuennen, XXVII. Experiments on the condensation and critical phenomena of some substances and mixtures, *Lond. Edinb. Dublin Philos. Mag. J. Sci.* 44 (1897) 174–199, doi:10.1080/14786449708621051.
- [1372] A.R.H. Goodwin, M.R. Moldover, Phase border and density determinations in the critical region of (carbon dioxide+ethane) determined from dielectric permittivity measurements, *J. Chem. Thermodyn.* 29 (1997) 1481–1494, doi:10.1006/jcht.1997.0257.
- [1373] R. Meyer, G. Giusti, É.-J. Vincent, M. Meyer, The thermodynamic properties of acetals+heptane mixtures at 298.15 K, *Thermochim. Acta.* 19 (1977) 153–160, doi:10.1016/0040-6031(77)85104-6.
- [1374] M.D. d'Almeida, J.G. Fernandez-Garcia, C.G. Boissonnas, Thermodynamique des mélanges liquides binaires. Chaleurs de mélange des cycloalcanes, *Helv. Chim. Acta.* 53 (1970) 1389–1394, doi:10.1002/hlca.19700530620.
- [1375] H. Watts, E.C.W. Clarke, D.N. Glew, New calorimeter for measurement of the enthalpy of mixing of liquids. The enthalpy of mixing of benzene with carbon tetrachloride and of n-hexane with cyclohexane, *Can. J. Chem.* 46 (1968) 815–821, doi:10.1139/v68-142.
- [1376] C. Yanes, J. Pellicer, E. Rojas, M. Zamora, Calorimetric cell for the measurement of excess enthalpy of volatile liquids. Excess enthalpy of cis-9-octadecenoic acid + cyclohexane at 298.15 K, *J. Chem. Thermodyn.* 11 (1979) 177–182, doi:10.1016/0021-9614(79)90168-X.
- [1377] S.D. Pradhan, G. Pathak, A simple calorimeter for the heats of mixing study of associated liquids: Enthalpy of hydrogen bonded ethanol–butylamine complex, *Proc. Indian Acad. Sci. - Chem. Sci.* 89 (1980) 341–347, doi:10.1007/BF02841404.
- [1378] J.J. Christensen, R.M. Izatt, D.J. Eatough, L.D. Hansen, The effect of pressure on the excess enthalpies of cyclohexane + n-hexane at 298.15 K, *J. Chem. Thermodyn.* 10 (1978) 25–34, doi:10.1016/0021-9614(78)90145-3.
- [1379] M.Paz Andrade, F. Lema, Enthalpies of mixing at medium temperatures: hexane–cyclohexane system, *Quim* 66 (1970) 527–530.
- [1380] B.S. Harsted, E.S. Thomsen, Excess enthalpies from flow microcalorimetry 1. Experimental method and excess enthalpies for carbon tetrachloride + cyclohexane, +benzene, and +octamethylcyclotetrasiloxane, and of n-hexane + cyclohexane, *J. Chem. Thermodyn.* 6 (1974) 549–555, doi:10.1016/0021-9614(74)90041-X.
- [1381] I.A. McLure, A.Trejo Rodriguez, Excess functions for (n-alkanenitrile + n-alkane) liquid mixtures 2. Excess enthalpies at 298.15 K for propanenitrile and n-butanenitrile with some C5 to C14 n-alkanes, *J. Chem. Thermodyn.* 14 (1982) 439–445, doi:10.1016/0021-9614(82)90136-7.
- [1382] A. Heintz, R.N. Lichtenthaler, An isothermal flow calorimeter for pressures to 600 bar, *Berichte Bunsenges. Für Phys. Chem.* 83 (1979) 853–856, doi:10.1002/bbpc.19790830816.
- [1383] R. Tanaka, P.J. D'Arcy, G.C. Benson, Application of a flow microcalorimeter to determine the excess enthalpies of binary mixtures of non-electrolytes, *Thermochim. Acta.* 11 (1975) 163–175, doi:10.1016/0040-6031(75)80020-7.
- [1384] R. Tanaka, S. Murakami, R. Fujishiro, An isothermal displacement calorimeter for measuring enthalpies of mixing, *Bull. Chem. Soc. Jpn.* 45 (1972) 2107–2110, doi:10.1246/bcsj.45.2107.
- [1385] F. Veselý, J. Pick, Heats of mixing of normal paraffin hydrocarbons with cyclohexane, application of the quasi-lattice theory, *Collect. Czechoslov. Chem. Commun.* 34 (1969) 1792–1796, doi:10.1135/cccc19691792.
- [1386] A. Heintz, R.N. Lichtenthaler, Kalorimetrische Untersuchungen von Ordnungsstrukturen in Alkanmischungen, *Berichte Bunsenges. Für Phys. Chem.* 81 (1977) 921–925, doi:10.1002/bbpc.19770811008.
- [1387] M.A. Siddiqi, K. Lucas, An isothermal high-pressure flow calorimeter the excess enthalpy of (cyclohexane + n-hexane) at different pressures at 288.15, 298.15, and 313.15 K, *J. Chem. Thermodyn.* 14 (1982) 1183–1190, doi:10.1016/0021-9614(82)90042-8.
- [1388] W.-D. Yan, R.-S. Lin, W.-H. Yen, Excess enthalpies of seven binary liquid systems, *Thermochim. Acta.* 169 (1990) 171–184, doi:10.1016/0040-6031(90)80143-M.
- [1389] J.D. Bao, Q.G. Muan, Y.Z. Xie, G.H. Zhao, *Huadong Huagong Xueyuan Xuebao* (1983) 267–271.
- [1390] J.D. Raal, P.A. Webley, Microflow calorimeter design for heats of mixing, *AIChE J* 33 (1987) 604–618, doi:10.1002/aic.690330409.
- [1391] N.N. Kedrina, L.V. Semenov, A.A. Gailé, Enthalpy of mixing of hydrocarbons with polar solvents, *Deposited Doc Onitexhim* (1981) 1–10.
- [1392] J. Gmehling, B. Krentscher, Excess enthalpies of 12 binary liquid mixtures containing cyclohexane at elevated temperatures and pressures (up to 416 K and 1.9 MPa), *ELDATA Int Electron. J. Phys.-Chem. Data* (1995) 181–190.
- [1393] O. Aufderhaar, Experimental determination of calorific data with a Tian-Calvet calorimeter and correlation of vapor pressure data of pure components with an extended Antoine equation, *Diplomarb. Oldenbg.* (1996) 1–96.
- [1394] F. Comelli, Heat of mixing for 1,3-dioxolane - methyl ethyl ketone system, *Chim Ind Milan* 71 (1989) 70–71.
- [1395] J. Krug, *Experimental Study of Excess Enthalpies and Excess Volumes of Binary Liquid Mixtures* (1985).
- [1396] T. Takigawa, M. Ohba, H. Ogawa, S. Murakami, Thermodynamic properties of binary mixtures of hexane isomer and cyclohexane at 298.15 K, *Fluid Phase Equilibria* 204 (2003) 119–130, doi:10.1016/S0378-3812(02)00217-0.
- [1397] Á. Piñeiro, Á. Olvera, G. García-Miaja, M. Costas, Excess Molar Enthalpies of Tetrahydrofuran or Diisopropyl Ether + 1-Alkanols at 298.15 K, Using a Newly Designed Flow Mixing Cell for an Isothermal Microcalorimeter, *J. Chem. Eng. Data.* 46 (2001) 1274–1279, doi:10.1021/jc0100645.
- [1398] D. Fenclová, P. Vrbka, V. Dohnal, K. Řehák, G. García-Miaja, Vapour + liquid equilibria and excess molar enthalpies for mixtures with strong complex formation. Trichloromethane or 1-bromo-1-chloro-2,2,2-trifluoroethane (halothane) with tetrahydropyran or piperidine, *J. Chem. Thermodyn.* 34 (2002) 361–376, doi:10.1006/jcht.2001.0953.
- [1399] K.L. Young, R.A. Mentzer, R.A. Greenkorn, K.C. Chao, Vapor–liquid equilibrium in mixtures of cyclohexane + benzene, + octene-1, + m-xylene, and + n-

- heptane, *J. Chem. Thermodyn.* 9 (1977) 979–985, doi:10.1016/0021-9614(77)90219-1.
- [1400] T. Katayama, E.K. Sung, E.N. Lightfoot, Isothermal activity coefficients for the system cyclohexane–n-heptane–toluene at 25°C, *AIChE J.* 11 (1965) 924–929, doi:10.1002/aic.690110533.
- [1401] J. Crutzen, R. Hasse, L. Sieg, *Z Naturforsch 5a* (1950) 600–604.
- [1402] U. Onken, W. Arlt, Recommended test mixtures for distillation columns, 2nd ed, *Inst. Chem. Eng. Rugby*. (1990).
- [1403] C.R. Chamorro, J.J. Segovia, M.C. Martín, M.A. Villamañán, Vapor–liquid equilibrium of octane-enhancing additives in gasolines: 3. Total pressure data and gE for ternary mixtures containing di-isopropyl ether or benzene and n-heptane + cyclohexane at 313.15 K, *Fluid Phase Equilibria* 191 (2001) 71–82, doi:10.1016/S0378-3812(01)00613-6.
- [1404] C.R. Chamorro, J.J. Segovia, M.C. Martín, M.A. Villamañán, Thermodynamics of Octane-Enhancing Additives in Gasolines: Vapor-Liquid Equilibrium of Binary and Ternary Mixtures Containing Di-isopropyl Ether or Heptane and 1-Hexene + Cyclohexane at 313.15 K, *J. Chem. Eng. Data*. 46 (2001) 1574–1579, doi:10.1021/je010065x.
- [1405] J.J. Segovia, M.C. Martín, C.R. Chamorro, M.A. Villamañán, Vapor-Liquid Equilibrium of Ternary Mixtures Containing Methyl tert-Butyl Ether and/or Substitution Hydrocarbons. Methyl tert-Butyl Ether + Heptane + Cyclohexane and Methyl tert-Butyl Ether + Cyclohexane + 1-Hexene at 313.15 K, *J. Chem. Eng. Data*. 43 (1998) 1021–1026, doi:10.1021/je980108i.
- [1406] T. Komori, S. Ohe, *Kagaku Kokaku Ronbunshu* 16 (1990) 384–387.
- [1407] A. Zorin, A. Kut'in, T. Kuznetsova, *Zh. Fiz. Khim.* 59 (1985) 3104–3106.
- [1408] H. Grosse-Wortmann, W. Jost, Calorimetric measurements of the system ethanol - cyclohexane - n-heptane, *Z. Phys. Chem. NF* 49 (1966) 74–93.
- [1409] D. Jain, O. Yadav, *Indian J. Chem.* 9 (1971) 342–345.
- [1410] T.E. Mairs, F.L. Swinton, The thermodynamic properties of binary mixtures containing an octane II. excess Gibbs functions, *J. Chem. Thermodyn.* 12 (1980) 575–580, doi:10.1016/0021-9614(80)90188-3.
- [1411] C.-C. Chen, M. Tang, Y.-P. Chen, Vapor-Liquid Equilibria of Binary and Ternary Mixtures of Cyclohexane, 3-Methyl-2-Butanone, and Octane at 101.3 kPa, *J. Chem. Eng. Data*. 41 (1996) 557–561, doi:10.1021/je950264e.
- [1412] P. Tancrede, D. Patterson, Excess enthalpy, Cyclohexane–n-octane system, *Int. Data Ser. Sel. Data Mix. Ser. A*. (1975) 114–120.
- [1413] R.L. Arenosa, C. Menduiña, G. Tardajos, M.Díaz Peña, Excess enthalpies at 298.15 K of binary mixtures of cyclohexane with n-alkanes, *J. Chem. Thermodyn.* 11 (1979) 159–166, doi:10.1016/0021-9614(79)90165-4.
- [1414] R.J. Hill, T.E. Mairs, F.L. Swinton, The thermodynamic properties of binary mixtures containing an octane III. excess enthalpies and excess volumes, *J. Chem. Thermodyn.* 12 (1980) 581–587, doi:10.1016/0021-9614(80)90189-5.
- [1415] Z. Hamoudi, F.B. Belaribi, A. Ait-Kaci, G. Boukais-Belaribi, Experimental and predicted excess molar enthalpies for 1,4-dioxane+octane+cyclohexane at 303.15K, *Fluid Phase Equilibria* 244 (2006) 62–67, doi:10.1016/j.fluid.2006.03.020.
- [1416] S.-K. Yang, JoséD. Gómez-Ibáñez, The excess enthalpies of cyclohexane + n-dodecane and + n-nonane, *J. Chem. Thermodyn.* 8 (1976) 209–216, doi:10.1016/0021-9614(76)90098-7.
- [1417] J.D. Gómez-Ibáñez, J.J.C. Shieh, E.M. Thorsteinson, The excess free energy of mixtures of cyclohexane and n-dodecane, *J. Phys. Chem.* 70 (1966) 1998–2002, doi:10.1021/j100878a048.
- [1418] C.A. Cerdeiriña, C.A. Tovar, D. González-Salgado, E. Carballo, L. Romani, Iso-baric thermal expansivity and thermophysical characterization of liquids and liquid mixtures, *Phys. Chem. Chem. Phys.* 3 (2001) 5230–5236, doi:10.1039/B104891K.
- [1419] H. Wagner, R.N. Lichtenthaler, Excess properties of liquid cyclohexane/hydrocarbon mixtures I. experimental results of the excess enthalpy, *Berichte Bunsenges. Für Phys. Chem.* 90 (1986) 65–68, doi:10.1002/bbpc.19860900110.
- [1420] S. Zhu, S. Shen, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of (ethanol or propan-1-ol + cyclohexane + decane) at the temperature 298.15 K, *J. Chem. Thermodyn.* 25 (1993) 909–917, doi:10.1006/jcht.1993.1088.
- [1421] J.D. Gómez-Ibáñez, J.J.C. Shieh, The excess free energy of mixtures of cyclohexane and n-hexadecane, *J. Phys. Chem.* 69 (1965) 1660–1666, doi:10.1021/j100889a036.
- [1422] D.V. Fenby, J.R. Khurma, Z.S. Kooner, T.E. Block, C.M. Knobler, J. Reeder, R.L. Scott, Isomer effects in mixtures of hydrocarbons: some experimental excess volumes and enthalpies, *Aust. J. Chem.* 33 (1980) 1927–1941, doi:10.1071/ch9801927.
- [1423] J.D. Gómez-Ibáñez, F.T. Wang, The excess Gibbs energy of mixtures of cyclohexane with n-icosane and with two other n-alkanes. A relation of congruence, *J. Chem. Thermodyn.* 3 (1971) 811–817, doi:10.1016/S0021-9614(71)80009-5.
- [1424] C.A. Tovar, C.A. Cerdeiriña, D. González, E. Carballo, L. Romani, Second-order excess derivatives for liquid mixtures of non-electrolytes, *Fluid Phase Equilibria* 169 (2000) 209–221, doi:10.1016/S0378-3812(00)00333-2.
- [1425] M. Teodorescu, A. Barhala, O. Landauer, *ELDATA Int. Electron. J. Phys. Chem. Data* 2 (1996) 169–174.
- [1426] E. Wilhelm, A. Inglese, J.P.E. Grolier, Excess enthalpies of cycloheptane + n-alkane and cyclooctane + n-alkane, *J. Chem. Eng. Data*. 28 (1983) 202–204, doi:10.1021/je00032a023.
- [1427] B. Marongiu, S. Porcedda, L. Lepori, E. Matteoli, The effect of the molecular shape on the enthalpic behaviour of liquid mixtures: cyclic hydrocarbons in heptane and tetrachloromethane, *Fluid Phase Equilibria* 108 (1995) 167–183, doi:10.1016/0378-3812(95)02692-8.
- [1428] W.L. Spiteri, T.M. Letcher, The excess enthalpies of cyclooctane + n-alkanes, *Thermochim. Acta.* 59 (1982) 73–80, doi:10.1016/0040-6031(82)87094-9.
- [1429] M.B. Ewing, K.N. Marsh, Excess Gibbs free energies, excess enthalpies, and excess volumes for mixtures of cyclopentane+2,3-dimethylbutane, *J. Chem. Thermodyn.* 5 (1973) 659–664, doi:10.1016/S0021-9614(73)80006-0.
- [1430] M.B. Ewing, K.N. Marsh, Excess Gibbs free energies, excess enthalpies, excess volumes, and isothermal compressibilities of cyclohexane+2,3-dimethylbutane, *J. Chem. Thermodyn.* 6 (1974) 35–41, doi:10.1016/0021-9614(74)90203-1.
- [1431] L. Romani, A. Paz, Excess thermodynamic functions at 25.deg. II. cyclohexane + hexane isomers, *Quim* 71 (1975) 3–6.
- [1432] M.B. Ewing, K.N. Marsh, Excess Gibbs free energies, excess enthalpies, and excess volumes of cycloheptane + 2,3-dimethylbutane, *J. Chem. Thermodyn.* 6 (1974) 43–47, doi:10.1016/0021-9614(74)90204-3.
- [1433] M.B. Ewing, K.N. Marsh, Excess Gibbs free energies, excess enthalpies, and excess volumes for 2,3-dimethylbutane+ cyclo-octane, *J. Chem. Thermodyn.* 5 (1973) 651–657, doi:10.1016/S0021-9614(73)80005-9.
- [1434] R. Battino, Thermodynamics of Binary Solutions of Nonelectrolytes with 2,2,4-Trimethylpentane. I. Volume of Mixing (25°) and Vapor-Liquid Equilibrium (35–75°) with Cyclohexane1a, *J. Phys. Chem.* 70 (1966) 3408–3416, doi:10.1021/j100883a007.
- [1435] D. Jain, O. Yadav, *Indian J. Chem.* 12 (1974) 721–723.
- [1436] H. Segura, R. Reich, G. Galindo, J. Wisniak, Phase Equilibria in the Systems Cyclohexane + 2,2,4-Trimethylpentane and Ethyl 1,1-Dimethylethyl Ether + Cyclohexane + 2,2,4-Trimethylpentane at 94.00 kPa, *J. Chem. Eng. Data*. 45 (2000) 600–605, doi:10.1021/je990243a.
- [1437] S.V. Subrahmanyam, E. Rajagopal, Excess Thermodynamic Functions of the Systems Isooctane + Carbon Tetrachloride and Isooctane + Cyclohexane, *Z. Für Phys. Chem.* 85 (1973) 256–268, doi:10.1524/zpch.1973.85.5.6.256.
- [1438] D.T. Dixon, F.A. Hewitt, Excess enthalpies and volumes for neopentane + cyclohexane and tetramethylsilane + cyclohexane at 298.15 K, *J. Chem. Thermodyn.* 10 (1978) 501–503, doi:10.1016/0021-9614(78)90098-8.
- [1439] D. Robinson, C. Chen, H. Ng, The equilibrium phase properties of selected naphthenic binary systems: ethylcyclohexane–carbon dioxide, ethylcyclohexane–nitrogen and ethylcyclohexane–methane, *Gas Process. Assoc. Res. Rep. RR-58*. (1981).
- [1440] S. Laugier, P. Alali, A. Valtz, A. Chareton, F. Fontalba, D. Richon, H. Renon, Vapor–liquid equilibria measurements on the systems N2–n-propylcyclohexane, CO2–n-propylcyclohexane, CH4–n-propylcyclohexane, CH4–n-propylbenzene and CO2–n-propylbenzene, *Gas Process. Assoc. Res. Rep. RR-75*. (1984).
- [1441] N.A. Darwish, K.A.M. Gasem, R.L. Robinson, Solubility of Methane in Cyclohexane and in trans-Decalin at Temperatures from 323 to 423 K at Pressures up to 9.6 MPa, *J. Chem. Eng. Data*. 43 (1998) 238–240, doi:10.1021/je970110u.
- [1442] P. Tobaly, P. Marteau, V. Ruffier-Meray, High-pressure phase diagrams of methane + decahydronaphthalene and methane + acenaphthene mixtures, *J. Chem. Eng. Data*. 46 (2001) 1269–1273, doi:10.1021/je0003748.
- [1443] H.H. Reamer, B. Sage, W. Lacey, *Chem Eng Data Ser* 3 (1958) 240–245.
- [1444] E.P. Schoch, A.E. Hoffmann, F.D. Mayfield, Solubility of Methane in Cyclohexane, *Ind. Eng. Chem.* 32 (1940) 1351–1353, doi:10.1021/ie50370a017.
- [1445] E. Brunner, S. Maier, K. Windhaber, Three high-pressure optical cells for phase equilibrium investigations, *J. Phys. [E]*, 17 (1984) 44–48, doi:10.1088/0022-3735/17/1/009.
- [1446] S. Hwang, Y. Lin, R. Kobayashi, *Gas Process. Assoc. Tech. Publ. TP-5*. (1978).
- [1447] R.J. Wilcock, R. Battino, E. Wilhelm, The solubility of gases in liquids 10. The solubility of He, Ne, Ar, Kr, N2, O2, CO, CO2, CH4, C4F4, and SF6 in cyclooctane at 289 to 313 K, *J. Chem. Thermodyn.* 9 (1977) 111–115, doi:10.1016/0021-9614(77)90075-1.
- [1448] W.B. Kay, R.E. Albert, Liquid-vapor equilibrium relations in the ethane-cyclohexane system, *Ind. Eng. Chem.* 48 (1956) 422–426, doi:10.1021/ie51398a024.
- [1449] J.H. Dymond, Solubility of a series of gases in cyclohexane and dimethylsulfoxide, *J. Phys. Chem.* 71 (1967) 1829–1831, doi:10.1021/j100865a043.
- [1450] S. Laugier, D. Richon, New apparatus to perform fast determinations of mixture vapor–liquid equilibria up to 10 MPa and 423 K, *Rev. Sci. Instrum.* 57 (1986) 469–472, doi:10.1063/1.1138909.
- [1451] H.S. Myers, Binary mixtures of naphthenes and aromatics, *Ind. Eng. Chem.* 48 (1956) 1104–1108, doi:10.1021/ie50558a041.
- [1452] R.W. Hermsen, J.M. Prausnitz, Thermodynamic properties of the benzene and cyclopentane system, *Chem. Eng. Sci.* 18 (1963) 485–494, doi:10.1016/0009-2509(63)85009-5.
- [1453] P.S. Arora, R.C. Phutela, P.P. Singh, Interaction of cyclopentane with benzene, carbon tetrachloride and cyclohexane, *Thermochim. Acta.* 10 (1974) 47–53, doi:10.1016/0040-6031(74)85022-7.
- [1454] A.E.P. Watson, I.A. McLure, J.E. Bennett, G.C. Benson, Excess Properties of Some Aromatic–Alicyclic Systems. I. Measurements of Enthalpies and Volumes of Mixing <sup>1</sup>, *J. Phys. Chem.* 69 (1965) 2753–2758, doi:10.1021/j100892a046.
- [1455] R. Tanaka, Excess heat capacities for mixtures of benzene with cyclopentane, methylcyclohexane, and cyclooctane at 298.15 K, *J. Chem. Eng. Data*. 30 (1985) 267–269, doi:10.1021/je00041a009.
- [1456] T. Kimura, S. Takagi, *Netsu Sokutei*. 5 (1978) 95–99.
- [1457] C.G. Osborne, K.W. Morcom, Thermodynamic behaviour of (hexafluorobenzene + a cyclic ether) I. excess Gibbs functions, *J. Chem. Thermodyn.* 13 (1981) 235–240, doi:10.1016/0021-9614(81)90122-1.
- [1458] T. Nitta, T. Akimoto, A. Matsui, T. Katayama, An apparatus for precise mea-

- surement of gas solubility and vapor pressure of mixed solvents, *J. Chem. Eng. Jpn.* 16 (1983) 352–356, doi:10.1252/jcej.16.352.
- [1459] R. Mitra, S. Bhattacharyya, *Indian J. Phys.* 45 (1971) 241–249.
- [1460] George Scatchard, S.E. Wood, J.M. Mochel, Vapor-liquid equilibrium. iii. benzene-cyclohexane mixtures, *J. Phys. Chem.* 43 (1939) 119–130, doi:10.1021/j150388a009.
- [1461] A.G. Morachevskii, Investigation of Solution-Vapor Equilibrium in the Benzene-Cyclohexane-Methylalcohol System, *Vestn Leningr Univ 12 Ser Fiz Khim 1* (1957) 118–126.
- [1462] T. Boublik, *Collect. Czech. Chem. Commun.* 28 (1963) 1771–1779.
- [1463] M. Diaz Peña, D.Rodríguez Cheda, Liquid-Vapor Equilibrium. I. Systems Benzene-Cyclohexane at 70° and Ethanol-n-Hexane at 50°, *Quim 66* (1970) 721–735.
- [1464] K. Aim, Measurement of vapor-liquid equilibrium in systems with components of very different volatility by the total pressure static method, *Fluid Phase Equilibria 2* (1978) 119–142, doi:10.1016/0378-3812(78)85004-3.
- [1465] M. Inoue, K. Azumi, N. Suzuki, A new vapor pressure assembly for static vapor-liquid equilibrium, *Ind. Eng. Chem. Fundam.* 14 (1975) 312–314, doi:10.1021/i160056a005.
- [1466] G. Kortum, H. Freier, *Chem. Ing. Technol.* 26 (1954) 670–673.
- [1467] S. Madhavan, P.S. Murit, Vapor-liquid equilibria of the system cyclohexane-methanol: ebulliometric method, *Chem. Eng. Sci.* 21 (1966) 465–468, doi:10.1016/0009-2509(66)85057-1.
- [1468] A. Tasic, B. Djordjevic, D. Grozdanic, Vapor-liquid equilibria of systems acetone-benzene, benzene-cyclohexane and acetone-cyclohexane 25 °C, *Chem. Eng. Sci.* 33 (2022) 189–197.
- [1469] L.M. Lozano, E.A. Montero, M.C. Martín, M.A. Villamañán, Vapor-liquid equilibria of binary mixtures containing methyl tert-butyl ether (MTBE) and/or substitution hydrocarbons at 298.15 K and 313.15 K, *Fluid Phase Equilibria 110* (1995) 219–230, doi:10.1016/0378-3812(95)02756-5.
- [1470] A.G. Morachevskii, Liquid-Vapor Equilibria in the Ternary System Benzene-Cyclohexane-Hexane, *Zh. Prikl. Khim.* 36 (1963) 2771–2773.
- [1471] A.R. Richards, E. Hargreaves, Vapor-Liquid Equilibria of Close-Boiling Binary Hydrocarbon Mixtures, *Ind. Eng. Chem.* 36 (1944) 805–808, doi:10.1021/ie50417a008.
- [1472] V. Nataraj, Isobaric Vapor-Liquid Equilibrium Data for the Binary Systems Benzene-Cyclohexane, Benzene-Isobutanol, and Cyclohexane-Isobutanol, *Indian J. Technol.* 5 (1967) 212–215.
- [1473] I. Nagata, Vapor-Liquid Equilibria for the Ternary System Methyl Acetate-Benzene-Cyclohexane, *J. Chem. Eng. Data.* 7 (1962) 461–466, doi:10.1021/je60015a004.
- [1474] J. Thornton, F. Garner, *J. Appl. Chem.* 1 (1951) S61–S68.
- [1475] L. Tao, *The University of Wisconsin* (1952).
- [1476] K. Chao, *The University of Wisconsin* (1956).
- [1477] K.C. Chao, O.A. Hougen, Vapor-liquid equilibria in the ternary system ethyl acetate-benzene-cyclohexane, *Chem. Eng. Sci.* 7 (1958) 246–260, doi:10.1016/0009-2509(58)85021-6.
- [1478] A. Boldyrev, V. Komarov, B. Krichevstov, *Zh. Prikl. Khim.* 46 (1973) 2338–2339.
- [1479] K. Kojima, M. Kato, H. Sunaga, G. Hashimoto, Simple Method for Measuring the Condensation Curve of a Binary System, *Kagaku Kogaku 32* (1968) 337–342.
- [1480] T. Hiaki, K. Tochigi, K. Kojima, Measurement of vapor-liquid equilibria and determination of azeotropic point, *Fluid Phase Equilibria 26* (1986) 83–102, doi:10.1016/0378-3812(86)85006-3.
- [1481] H.G. Grimm, *Z Phys. Ch.* 140 (1929) 321.
- [1482] E.R. Brewster, M.L. McGlashan, Determination of excess Gibbs functions of binary liquid mixtures from measurements of dew pressure and composition of vapour. Test of the method on benzene+cyclohexane, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases.* 69 (1973) 2046–2053, doi:10.1039/F19736902046.
- [1483] M. Susarev, N. Martynova, G. Efimova, *Zh. Prikl. Khim.* 50 (1977) 1823–1828.
- [1484] Z. J. P. Oracz, S. Warycha, Total vapour pressure measurements and excess Gibbs energies for the binary systems methanol+ethanol, ethanol+2-propanol, benzene+cyclohexane, benzene+carbon tetrachloride and benzene+ethanol at 303.15 and 313.15 K, *Fluid Phase Equilibria 58* (1990) 191–209, doi:10.1016/0378-3812(90)87014-G.
- [1485] J. Munoz-Embidi, M. Gallardo, J. Fernandez, *Quim.* 87 (1991) 867–872.
- [1486] M. Kato, Analysis of the excess Gibbs energies of binary mixtures using non-randomness factors determined from excess volume data, *Bull. Chem. Soc. Jpn.* 55 (1982) 23–27, doi:10.1246/bcsj.55.23.
- [1487] D.T. Dixon, F.A. Hewitt, Excess Gibbs function for a binary mixture obtained from dew point and bubble point pressure measurements, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases.* 75 (1979) 1940–1949, doi:10.1039/F19797501940.
- [1488] H. Bittlich, G. Zimmermann, E. Schaar, *Z Phys Chem Leipzig* 260 (1979) 1005–1008.
- [1489] K. Tochigi, T. Hiaki, Report of the Research Institute of Science and Technology, *Nihon Univ.* (1983).
- [1490] N. van Nhu, G. Nowak, P. Svejda, Excess gibbs energies of some liquid mixtures with polar components, effects of local polarizability, *Berichte Bunsenges. Für Phys. Chem.* 92 (1988) 1537–1543, doi:10.1002/bbpc.198800364.
- [1491] K. Kurihara, M. Uchiyama, K. Kojima, Isothermal Vapor-Liquid Equilibria for Benzene+Cyclohexane+1-Propanol and for Three Constituent Binary Systems, *J. Chem. Eng. Data.* 42 (1997) 149–154, doi:10.1021/je9602475.
- [1492] C. Lafuente, J. Pardo, J. Santate, *Rev Acad Cienc Exactas Fis Quim Nat Zaragoza 47* (1992) 183–190.
- [1493] P. Sabarathinam, A. Andiappan, *Indian Chem. Eng.* 23 (1981) 51–55.
- [1494] JoséJ. Segovia, M.C. Martín, C.R. Chamorro, M.A. Villamañán, Excess thermodynamic functions for ternary systems containing fuel oxygenates and substitution hydrocarbons. 1. Total-pressure data and GE for methyl tert-butyl ether benzene cyclohexane at 313.15 K, *Fluid Phase Equilibria 133* (1997) 163–172, doi:10.1016/S0378-3812(97)00011-3.
- [1495] A. Barhala, D. Dragoescu, *Rev. Roum. Chim.* 46 (2001) 773–778.
- [1496] J.R. Lacher, W.B. Buck, W.H. Parry, Vapor Pressure Studies. II. Chlorobenzene-1-Nitropropane <sup>1</sup>, *J. Am. Chem. Soc.* 63 (1941) 2422–2425, doi:10.1021/ja01854a030.
- [1497] B.I. Mattingley, D.V. Fenby, Thermodynamic study of the deuterium isotope effect, the molar excess enthalpies of C6D6+c-C6H12 and of C6H6+c-C6H12, *Aust. J. Chem.* 28 (1975) 185–187, doi:10.1071/ch9750185.
- [1498] I. Nagata, K. Tamura, S. Ozaki, K. Myoken, Ternary excess molar enthalpies of chloroform+acetone+cyclohexane mixtures at 298.15 K, *Thermochim. Acta.* 209 (1992) 31–41, doi:10.1016/0040-6031(92)80182-V.
- [1499] T. Murakami, S. Murakami, R. Fujishiro, Heat of Mixing for Binary Mixtures: Pyridine Derivatives + Benzene, and +Cyclohexane Systems, *Bull. Chem. Soc. Jpn.* 42 (1969) 35–40, doi:10.1246/bcsj.42.35.
- [1500] M. Diaz Peña, F.Fernandez Martín, Thermodynamics of Mixtures of Normal Alcohols. Part 1. Heat of Mixing of the System n-Butanol - Methanol at 25 °C, *R Soc Esp Fis Quim Ser B 59* (1963) 323–330.
- [1501] I. Nagata, K. Kazuma, Heats of mixing for the ternary system ethanol-1-propanol-cyclohexane at 25.degree.C, *J. Chem. Eng. Data.* 22 (1977) 79–84, doi:10.1021/je60072a013.
- [1502] D. Bares, M. Soulie, J. Metzger, Experimental calorimetric and ebulliometric methods for determining the excess thermodynamic functions or organic liquids. Applications to binary systems composed of azaromatic bases and an apolar solvent, *J Chim Phys Physicochim Biol 70* (1973) 1531–1539.
- [1503] S. Cabani, N. Ceccanti, Thermodynamic properties of binary mixtures of cyclohexane with cyclic amines or cyclic ethers at 298.15 K, *J. Chem. Thermodyn.* 5 (1973) 9–20, doi:10.1016/S0021-9614(73)80058-8.
- [1504] B.A. Coomber, C.J. Wormald, A stirred flow calorimeter the excess enthalpies of acetone+water and of acetone+some normal alcohols, *J. Chem. Thermodyn.* 8 (1976) 793–799, doi:10.1016/0021-9614(76)90058-6.
- [1505] K. Elliott, C.J. Wormald, A precision differential flow calorimeter the excess enthalpy of benzene+cyclohexane between 280.15 K and 393.15 K, *J. Chem. Thermodyn.* 8 (1976) 881–893, doi:10.1016/0021-9614(76)90166-X.
- [1506] L. Abello, Excess heats of binary systems containing benzene hydrocarbons and chloroform or methylchloroform. I. experimental results, *J Chim Phys Physicochim Biol 70* (1973) 1355–1359.
- [1507] J.R. Goates, R.J. Sullivan, J.B. Ott, Heats of mixing in the system carbon tetrachloride-cyclohexane-benzene, *J. Phys. Chem.* 63 (1959) 589–594, doi:10.1021/j150574a034.
- [1508] J.R. Battler, W.M. Clark, R.L. Rowley, Excess enthalpy and liquid-liquid equilibrium surfaces for the cyclohexane-2-propanol-water system from 293.15 to 323.15 K, *J. Chem. Eng. Data.* 30 (1985) 254–259, doi:10.1021/je00041a006.
- [1509] V. Sabinin, V. Belousov, A. Morachevskii, Heat of mixing and heat of vaporization in the system benzene - cyclohexane, *Izv Vyssh Uchebn Zaved Khim Khim Tekhnol 9* (1966) 382–386.
- [1510] D.E. Nicholson, Heats of Mixing of Benzene and Cyclohexane, *J. Chem. Eng. Data.* 6 (1961) 5, doi:10.1021/je60009a002.
- [1511] M.Paz Andrade, J. Ocon, J. Casanova, Heats of mixing near the boiling point. I. Benzene-cyclohexane, *R. Soc. Esp. Fis. Quim. Ser. B 61* (1965) 707–716.
- [1512] M. Gracia, An isothermal dilution calorimeter for positive enthalpies of mixing, *J. Chem. Thermodyn.* 9 (1977) 55–59, doi:10.1016/0021-9614(77)90196-3.
- [1513] J.H. Obbink, J.C. van Miltenburg, G.J.K. van den Berg, An isothermal displacement calorimeter for positive excess enthalpies, *J. Chem. Thermodyn.* 10 (1978) 691–699, doi:10.1016/0021-9614(78)90112-X.
- [1514] R.S. Murray, M.L. Martin, Excess enthalpies of hexafluorobenzene+diethyl ether, +di-isopropyl ether, and +di-n-butyl ether at 283.15 and 298.15 K, *J. Chem. Thermodyn.* 10 (1978) 711–720, doi:10.1016/0021-9614(78)90129-5.
- [1515] I. Fujihara, M. Kobayashi, S. Murakami, Excess enthalpies of trans-decalin+benzene, +toluene, +iso-octane, and +heptane at 298.15 K, *J. Chem. Thermodyn.* 15 (1983) 1–6, doi:10.1016/0021-9614(83)90097-6.
- [1516] M.K. Kumaran, C.J. Halpin, G.C. Benson, Limiting excess partial molar enthalpies of hexan-1-ol, 2-methylpentan-1-ol, and 2-ethylbutan-1-ol in n-hexane at 298.15 K, *J. Chem. Thermodyn.* 15 (1983) 249–252, doi:10.1016/0021-9614(83)90116-7.
- [1517] A.V. Ratnam, C.V. Rao, P.S. Murti, Thermodynamic properties of liquid mixtures—heats of mixing at 35°C: Systems: benzene-cyclohexane-ethyl acetate and the three related binaries, *Chem. Eng. Sci.* 17 (1962) 392–396, doi:10.1016/0009-2509(62)80041-4.
- [1518] R.J. Hill, F.L. Swinton, The excess enthalpies of some mixtures containing carbon disulphide, *J. Chem. Thermodyn.* 12 (1980) 489–492, doi:10.1016/0021-9614(80)90063-4.
- [1519] H. Touhara, M. Ikeda, K. Nakanishi, N. Watanabe, An isothermal dilution calorimeter for measuring excess enthalpies, *J. Chem. Thermodyn.* 7 (1975) 887–893, doi:10.1016/0021-9614(75)90098-1.
- [1520] M. Karvo, Thermodynamic properties of binary and ternary mixtures containing sulfolane V. Excess enthalpies of cyclohexane+benzene, cyclohex-

- ane + toluene, benzene + sulfolane, and toluene + sulfolane, *J. Chem. Thermodyn.* 12 (1980) 635–639, doi:10.1016/0021-9614(80)90085-3.
- [1521] R.H. Stokes, K.N. Marsh, R.P. Tomlins, An isothermal displacement calorimeter for endothermic enthalpies of mixing, *J. Chem. Thermodyn.* 1 (1969) 211–221, doi:10.1016/0021-9614(69)90059-7.
- [1522] G.L. Nicolaidis, C.A. Eckert, Experimental heats of mixing of some miscible and partially miscible nonelectrolyte systems, *J. Chem. Eng. Data.* 23 (1978) 152–156, doi:10.1021/je60077a018.
- [1523] H. van Ness, M. Abbot, *Excess Enthalpy, Int Data Ser Sel Data Mix. Ser A.* (1974) 160–161.
- [1524] F. Veselý, V. Hynek, V. Svoboda, R. Holub, Isothermal calorimeter for measuring endothermic heats of mixing, *Collect. Czechoslov. Chem. Commun.* 39 (1974) 355–365, doi:10.1135/cccc19740355.
- [1525] F. Veselý, J. Pick, Heats of mixing of normal alcohols with cyclohexane, *Collect. Czechoslov. Chem. Commun.* 34 (1969) 1854–1874, doi:10.1135/cccc19691854.
- [1526] R. Mrázek, *Heats of Mixing: Binary Alcohol-Aromatic Systems at 25, 35, and 45 °C* (1960).
- [1527] A. Orszagh, T. Kasprzycka-Guttman, Thermodynamic properties of some heterocyclic base-aliphatic n-alcohols systems, *Bull Acad Pol Sci Ser Sci Chim* 20 (1972) 349–354.
- [1528] A. Ait-Kaci, 1982.
- [1529] B.S. Lark, S. Kaur, S. Singh, Ternary heat effects in ternary mixtures, *Thermochim. Acta.* 105 (1986) 219–229, doi:10.1016/0040-6031(86)85239-X.
- [1530] O. Dahmani, A. Ait-Kaci, Chaleurs de melanges a 298.15 K du systeme ternaire cyclohexane (1)+benzene (2)+1-chlorobutane (3), *J. Therm. Anal. Calorim.* 42 (1994) 963–971, doi:10.1007/BF02547118.
- [1531] J. Lohmann, R. Böltz, J. Gmehling, Excess enthalpy data for seven binary systems at temperatures between 50 and 140 °C, *J. Chem. Eng. Data.* 46 (2001) 208–211, doi:10.1021/je000297g.
- [1532] J. Coca, *Physical-Chemical Properties of Liquid Binary Mixtures: Viscosity and Heat of Mixing, Acta Salmant Cienc* 33 (1969) 9–39.
- [1533] H. Casas, L. Segade, S. García-Garabal, M.M. Piñeiro, C. Franjo, E. Jiménez, M.I. Paz Andrade, Excess molar enthalpies for propyl propanoate + cyclohexane + benzene at 298.15 and 308.15 K, *Fluid Phase Equilibria* 182 (2001) 279–288, doi:10.1016/S0378-3812(01)00403-4.
- [1534] P. Devika, T. Ramachandran, M. Ananth, *Enthalpy of mixing of five binary mixtures, Indian J. Technol.* 30 (1992) 612–614.
- [1535] M. Kuus, H. Kirss, E. Siimer, L. Kudryavtseva, Excess enthalpies for the systems 1,3-butanediol + cyclohexanol + decane and 1,2-propanediol + 1,3-butanediol + cyclohexanol and for constituent binaries at 318.15 K, *J. Chem. Eng. Data.* 41 (1996) 1206–1209, doi:10.1021/je960171c.
- [1536] R. Páramo, M. Zouine, C. Casanova, New Batch Cells Adapted To Measure Saturated Heat Capacities of Liquids, *J. Chem. Eng. Data.* 47 (2002) 441–448, doi:10.1021/je0155103.
- [1537] J.-P.E. Grolier, E. Wilhelm, M.H. Hamed, Molar Heat Capacity and Isothermal Compressibility of Binary Liquid Mixtures: Carbon Tetrachloride + Benzene, Carbon Tetrachloride + Cyclohexane and Benzene + Cyclohexane, *Berichte Bunsenges. Für Phys. Chem.* 82 (1978) 1282–1290, doi:10.1002/bbpc.19780821204.
- [1538] R. Tanaka, Determination of excess heat capacities of (benzene + tetrachloromethane and + cyclohexane) between 293.15 and 303.15 K by use of a Picker flow calorimeter, *J. Chem. Thermodyn.* 14 (1982) 259–268, doi:10.1016/0021-9614(82)90016-7.
- [1539] R.C. Mitra, S.C. Guhaniyogi, S.N. Bhattacharyya, Effect of size and shape in binary nonelectrolyte solutions. I. Measurement of excess free energy and excess volume of benzene-cyclooctane and toluene-cyclooctane, *J. Chem. Eng. Data.* 18 (1973) 147–151, doi:10.1021/je60057a025.
- [1540] T.M. Letcher, D.M. Perkins, Application of the flory theory of liquid mixtures to excess volumes and enthalpies of benzene + cycloalkane and + n-alkane mixtures, *Thermochim. Acta.* 77 (1984) 267–274, doi:10.1016/0040-6031(84)87066-5.
- [1541] E. Wilhelm, A. Inglese, J.-P.E. Grolier, Excess enthalpies of binary mixtures of cycloheptane or cyclooctane with benzene or toluene or ethylbenzene at 298.15 K, *Thermochim. Acta.* 229 (1993) 271–280, doi:10.1016/0040-6031(93)80334-7.
- [1542] V. Zharov, A. Morachevskii, L. Shapil, *Zh. Prikl. Khim.* 41 (1968) 2443–2450.
- [1543] Z. Anisimova, E. Konakbaeva, M. Shakhparanov, *Teplofiz Svoistva Veshchestv Mater* (1973) 167–171.
- [1544] J. Gaube, S. Hammer, A. Pfennig, A new equilibrium cell with variable cell volume for static vapour-pressure measurements, *Fluid Phase Equilibria* 123 (1996) 245–257, doi:10.1016/S0378-3812(96)90033-3.
- [1545] A. Delzenne, *Bull. Soc. Chim. Fr.* (1961) 295–298.
- [1546] F. Rivencq, *Bull. Soc. Chim. Fr.* (1969) 3034–3035.
- [1547] J. Choliński, M. Palczewska-Tulińska, A. Szafrńska, D. Wyrzykowskaskankiewicz, A new method of parameter adjustment and diagnostic checks on gamma models used in vapor–liquid equilibrium calculations, *Chem. Eng. Sci.* 36 (1981) 173–181, doi:10.1016/0009-2509(81)80061-9.
- [1548] C. de Alfonso, A. Canovas, B. Llanas, M. Pintado, A.F. Saenz de la Torre, *Quim Ser A* 82 (1986) 320–330.
- [1549] S. Korobkov, V. Zharov, N. Inozemtseva, *Zh. Prikl. Khim.* 53 (1980) 81–85.
- [1550] R.J. Zemp, A.Z. Francesconi, Salt effect on phase equilibria by a recirculating still, *J. Chem. Eng. Data.* 37 (1992) 313–316, doi:10.1021/je00007a010.
- [1551] T. Kaiser, C. Voßmerbäumer, G. Schweiger, A new approach to the determination of fluid phase Equilibria: Concentration measurements by Raman spectroscopy, *Berichte Bunsenges. Für Phys. Chem.* 96 (1992) 976–980, doi:10.1002/bbpc.19920960805.
- [1552] V. Cano, A. Francesconi, *Lat. Am. Appl. Res.* 20 (1990) 65–68.
- [1553] K. Amaya, Thermodynamical Studies on Binary Systems Consisting of Polar and Non-polar Liquids. II. The Measurement of the Heats of Mixing for Binary Systems of Polar and Non-polar Liquids, *Bull. Chem. Soc. Jpn.* 34 (1961) 1278–1285, doi:10.1246/bcsj.34.1278.
- [1554] S. Fujii, K. Tamura, S. Murakami, Thermodynamic properties of (an alkylbenzene + cyclohexane) at the temperature 298.15 K, *J. Chem. Thermodyn.* 27 (1995) 1319–1328, doi:10.1006/jcht.1995.0140.
- [1555] D. Jain, O. Yadav, *Indian J. Chem.* 12 (1974) 718–720.
- [1556] C. Díaz, J. Tojo, Isobaric Vapor-Liquid Equilibria of the Binary Systems Cyclohexane with o-Xylene, m-Xylene, p-Xylene, and Ethylbenzene at 101.3 kPa, *J. Chem. Eng. Data.* 47 (2002) 1154–1158, doi:10.1021/je0103263.
- [1557] S. Murakami, R. Fujishiro, Thermochemical Evidence of OH– $\pi$  Type Intermolecular Hydrogen Bonds, *Bull. Chem. Soc. Jpn.* 40 (1967) 1784–1789, doi:10.1246/bcsj.40.1784.
- [1558] D. Dragoescu, A. Barbhala, R. Viicu, *ELDATA Int Electron J Phys Chem Data* 3 (1997) 85–87.
- [1559] V. Rattan, B. Sethi, S. Singh, *Indian Chem. Eng.* 30 (1988) 28–34.
- [1560] D.V.S. Jain, O.P. Yadav, Vapour pressures and excess Gibbs energies of cyclohexane + o-xylene, + m-xylene, and + p-xylene, *J. Chem. Thermodyn.* 5 (1973) 541–544, doi:10.1016/S0021-9614(73)80101-6.
- [1561] M. Paz-Andrade, M. Amor, Heats of mixing at 25 deg. of the systems cyclohexane-o-xylene, cyclohexane-m-xylene, and cyclohexane-p-xylene, *Quim* 66 (1970) 717–720.
- [1562] E. Rajagopal, S.V. Subrahmanyam, Excess Thermodynamic Functions of the Systems Cyclohexane+Isomeric Xylenes, *Bull. Chem. Soc. Jpn.* 54 (1981) 282–284, doi:10.1246/bcsj.54.282.
- [1563] D. Jain, O. Yadav, K. Kamra, *Indian J. Chem.* 9 (1971) 1262–1264.
- [1564] H.T. French, R.H. Stokes, Thermodynamics of ethanol at low concentrations in mixtures of cyclohexane and 1,4-dimethylbenzene, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases.* 81 (1985) 1459–1465, doi:10.1039/F19858101459.
- [1565] I. Nagata, Y. Ogasawara, Prediction of ternary excess enthalpies from binary data, *Thermochim. Acta.* 52 (1982) 155–168, doi:10.1016/0040-6031(82)85193-9.
- [1566] A. Nissema, T. Kaivamo, M. Karvo, Thermodynamic properties of binary and ternary systems XII. Excess enthalpies of cyclohexane + p-xylene, p-xylene + dimethylsulfoxide, and dimethylsulfoxide + cyclohexane + p-xylene, *J. Chem. Thermodyn.* 15 (1983) 1083–1086, doi:10.1016/0021-9614(83)90033-2.
- [1567] A. Gupta, S. Gupta, F.R. Groves, E. McLaughlin, Measurement of vapor–liquid equilibrium for binary systems containing polynuclear aromatic compounds, *Fluid Phase Equilibria* 65 (1991) 305–326, doi:10.1016/0378-3812(91)87032-5.
- [1568] C.H. Lee, D.M. Dempsey, R.S. Mohamed, G.D. Holder, Vapor-liquid equilibria in the systems of n-decane/tetralin, n-hexadecane/tetralin, n-decane/1-methylnaphthalene, and 1-methylnaphthalene/tetralin, *J. Chem. Eng. Data.* 37 (1992) 183–186, doi:10.1021/je00006a012.
- [1569] M.C. Thies, W.E. Daniel, M.A. Todd, Vapor-liquid equilibrium for tetralin/toluene mixtures at elevated temperatures and pressures, *J. Chem. Eng. Data.* 33 (1988) 134–136, doi:10.1021/je00052a022.
- [1570] T.M. Letcher, B.W. Scoones, The excess enthalpies of 1,2,3,4-tetrahydronaphthalene + each of four n-alkanes and + each of four cycloalkanes at two temperatures, *J. Chem. Thermodyn.* 14 (1982) 831–835, doi:10.1016/0021-9614(82)90156-2.
- [1571] H. Inomata, K. Tuchiya, K. Arai, S. Saito, Measurement of Vapor-Liquid Equilibria at Elevated Temperatures and Pressures Using a Flow Type Apparatus, *J. Chem. Eng. Jpn.* 19 (1986) 386–391, doi:10.1252/jcej.19.386.
- [1572] T.M. Letcher, R.C. Baxter, Excess volumes and enthalpies of mixing benzene with various bicyclic compounds, *J. Solut. Chem.* 14 (1985) 35–40, doi:10.1007/BF00646728.
- [1573] K. Noda, M. Sakai, K. Ishida, Isothermal vapor-liquid equilibria for the propane-propylene-tetralin system, *J. Chem. Eng. Data.* 27 (1982) 32–34, doi:10.1021/je00027a009.
- [1574] B. Blanco, S. Beltran, J.L. Cabezas, J. Coca, Vapor-liquid equilibria of coal-derived liquids. 3. Binary systems with tetralin at 200 mm mercury, *J. Chem. Eng. Data.* 39 (1994) 23–26, doi:10.1021/je00013a007.
- [1575] J.E. Coon, J.E. Auwaerter, E. McLaughlin, A comparison of solid–liquid equilibrium with vapor–liquid equilibrium for prediction of activity coefficients in systems containing polynuclear aromatics, *Fluid Phase Equilibria* 44 (1989) 305–345, doi:10.1016/0378-3812(89)80060-3.
- [1576] M.B. Ewing, K.N. Marsh, Enthalpies of mixing of cyclohexane + carbon tetrachloride, of cyclohexane + cyclopentane, and of carbon tetrachloride + cyclopentane at various temperatures, *J. Chem. Thermodyn.* 2 (1970) 351–358, doi:10.1016/0021-9614(70)90005-4.
- [1577] M.B. Ewing, K.N. Marsh, Excess functions for cyclopentane+cyclohexane, cyclopentane+cycloheptane, and cyclohexane+cyclo-octane, *J. Chem. Thermodyn.* 6 (1974) 395–406, doi:10.1016/0021-9614(74)90170-0.
- [1578] M.B. Ewing, B.J. Levien, K.N. Marsh, R.H. Stokes, Excess enthalpies, excess volumes, and excess gibbs free energies for mixtures of cyclo-octane+cyclopentane at 288.15, 298.15, and 308.15 K, *J. Chem. Thermodyn.* 2 (1970) 689–695, doi:10.1016/0021-9614(70)90044-3.
- [1579] R.H. Stokes, K.N. Marsh, R.P. Tomlins, Enthalpies of exothermic mixing measured by the isothermal displacement calorimeter for cyclo-

- octane + cyclopentane at 25 °C, *J. Chem. Thermodyn.* 1 (1969) 377–379, doi:10.1016/0021-9614(69)90067-6.
- [1580] M.B. Ewing, K.N. Marsh, Excess functions for cyclohexane + cycloheptane and cycloheptane + cyclo-octane, *J. Chem. Thermodyn.* 6 (1974) 1087–1096, doi:10.1016/0021-9614(74)90071-8.
- [1581] M. Susarev, R. Lyzlova, *Zh. Fiz. Khim.* 36 (1962) 437–442.
- [1582] R.M. Weatherford, M. Van Winkle, Vapor-liquid equilibria of the quinary system hexane, methylcyclopentane, cyclohexane, benzene, and toluene, *J. Chem. Eng. Data.* 15 (1970) 386–390, doi:10.1021/je60046a011.
- [1583] M.A. Siddiqi, P. Svejda, F. Kohler, A Generalized van der Waals Equation of State II. Excess Heat Capacities of Mixtures Containing Cycloalkanes (C5, C6) Methylcycloalkanes (C5, C6) and n-Decane, *Berichte Bunsenges. Für Phys. Chem.* 87 (1983) 1176–1181, doi:10.1002/bbpc.19830871218.
- [1584] W.E. Ehrett, J.H. Weber, Vapor-Liquid Equilibria at Atmospheric and Sub-atmospheric Pressures for System n-Hexane-Methylcyclopentane, *J. Chem. Eng. Data.* 4 (1959) 142–145, doi:10.1021/je60002a010.
- [1585] E. Wilhelm, A. Ingiese, J.-P.E. Grolier, Excess enthalpies of binary mixtures containing either methylcyclopentane or methylcyclohexane, *Thermochim. Acta.* 187 (1991) 113–120, doi:10.1016/0040-6031(91)87186-Z.
- [1586] X. Zhang, Y. Zheng, W. Zhao, Measurement and correlation of vapor liquid equilibrium data for benzene cyclohexane methyl cyclohexane DMF systems, *Nat. Gas Chem. Ind.* 22 (1997) 52–55.
- [1587] K. Tamura, Excess heat capacities of the mixtures containing methylcyclohexane at 298.15 K, *Fluid Phase Equilibria* 182 (2001) 303–312, doi:10.1016/S0378-3812(01)00407-1.
- [1588] F. Veselý, A.V. Mikulič, V. Svoboda, J. Pick, Heats of mixing of normal alcohols with methylcyclohexane, *Collect. Czechoslov. Chem. Commun.* 40 (1975) 2551–2559, doi:10.1135/cccc19752551.
- [1589] H. Brandt, Calorimeter for measuring small heats of mixture in binary liquid systems, *Z Phys Chem Muenchen Ger* (1954) 104–111.
- [1590] D.E.G. Jones, I.A. Weeks, G.C. Benson, Excess Thermodynamic Properties of Cyclopentane – Isomeric Decalin Systems at 25 °C, *Can. J. Chem.* 49 (1971) 2481–2489, doi:10.1139/v71-409.
- [1591] T. Boublík, G.C. Benson, Vapor-Liquid Equilibria of Cyclohexane-cis-Decalin Mixtures at 25 °C, *Can. J. Chem.* 50 (1972) 1978–1980, doi:10.1139/v72-317.
- [1592] Y. Shiohama, H. Ogawa, S. Murakami, I. Fujihara, Excess thermodynamic properties of (cis-decalin or trans-decalin + cyclohexane or methylcyclohexane or cyclooctane) at 298.15 K, *J. Chem. Thermodyn.* 20 (1988) 1307–1314, doi:10.1016/0021-9614(88)90167-X.
- [1593] G.C. Benson, S. Murakami, V.T. Lam, J. Singh, Molar excess enthalpies and volumes of cyclohexane – isomeric decalin systems at 25 °C, *Can. J. Chem.* 48 (1970) 211–218, doi:10.1139/v70-035.
- [1594] T.M. Letcher, W.L. Spiteri, B.W. Scoones, Excess enthalpies of decahydronaphthalene in cycloalkanes and inn-Alkanes at two temperatures, *J. Solut. Chem.* 11 (1982) 423–434, doi:10.1007/BF00649041.
- [1595] S. Malanowski, B. Zegalska, *Inst Phys Chem Pol Acad Sci War Szawa Unpubl. Results.* (2022).
- [1596] S. Loras, A. Aucejo, R. Muñoz, Phase equilibria in the systems 3-methylpentane + methylcyclohexane, diisopropyl ether + methylcyclohexane and 3-methylpentane + diisopropyl ether + methylcyclohexane at 101.3 kPa, *Fluid Phase Equilibria* 194–197 (2002) 957–968, doi:10.1016/S0378-3812(01)00653-7.
- [1597] H. Segura, R. Reich, G. Galindo, J. Wisniak, Phase Equilibria in the Systems Ethyl 1,1-Dimethylethyl Ether + Methylcyclohexane, 2,2,4-Trimethylpentane + Methylcyclohexane, and Ethyl 1,1-Dimethylethyl Ether + 2,2,4-Trimethylpentane + Methylcyclohexane at 94.00 kPa, *J. Chem. Eng. Data.* 44 (1999) 912–917, doi:10.1021/je980320m.
- [1598] Z. Wang, G.C. Benson, B.C.-Y. Lu, Excess enthalpies of the ternary mixtures: (tetrahydrofuran+(2,2,4-trimethylpentane or heptane)+methylcyclohexane) at the temperature 298.15K, *J. Chem. Thermodyn.* 34 (2002) 2073–2082, doi:10.1016/s0021-9614(02)00264-1.
- [1599] D.V.S. Jain, S.B. Saini, R. s Sidhu, Excess Gibbs free energies of methylcyclohexane + benzene, + methylbenzene, and + ethylbenzene at 303.15 and 323.15 K, *J. Chem. Thermodyn.* 14 (1982) 689–693, doi:10.1016/0021-9614(82)90084-2.
- [1600] N. Asmanova, M. Goral, Vapor pressures and excess Gibbs energies in binary mixtures of hydrocarbons at 313.15 K. 1. Methylcyclohexane-benzene, -toluene, -o-xylene, -p-xylene, -ethylbenzene, and -propylbenzene, *J. Chem. Eng. Data.* 25 (1980) 159–161, doi:10.1021/je60085a009.
- [1601] W. Wóycicki, Excess enthalpies of binary mixtures containing unsaturated hydrocarbons 4. n-Diene + n-alkane and + cyclohexane, *J. Chem. Thermodyn.* 12 (1980) 165–171, doi:10.1016/0021-9614(80)90126-3.
- [1602] J.P.E. Grolier, A. Ingiese, E. Wilhelm, Excess enthalpies of binary systems of cyclic ether + cyclohexene, *J. Chem. Eng. Data.* 27 (1982) 333–335, doi:10.1021/je00029a031.
- [1603] W. Wóycicki, Excess enthalpies of (cyclohexylamine or aniline + cyclohexane or cyclohexene or a cyclohexadiene), *J. Chem. Thermodyn.* 18 (1986) 317–322, doi:10.1016/0021-9614(86)90076-5.
- [1604] S. Stoeck, *FIZ Rep.* (1975).
- [1605] C.S. Howat, G.W. Swift, Vapor-liquid phase equilibria for the binaries isoprene-dicyclopentadiene and n-pentane-dicyclopentadiene at 313 and 323 K, *J. Chem. Eng. Data.* 30 (1985) 281–285, doi:10.1021/je00041a014.
- [1606] T. Lesteva, S. Ogorodnikov, A. Morozova, *J Appl Chem USSR* 40 (1967) 853–856.
- [1607] M.G. Bernardo-Gil, M.A. Ribeiro, Vapor-liquid equilibria of binary system based on pine resin, *Fluid Phase Equilibria* 53 (1989) 15–22, doi:10.1016/0378-3812(89)80068-8.
- [1608] F. Farelo, F.S. And, L. Serrano, Isobaric vapor liquid equilibrium in binary mixtures of  $\alpha$ -pinene, limonene and 1, 8-cineole, *Can. J. Chem. Eng.* 69 (1991) 794–799, doi:10.1002/cjce.5450690323.
- [1609] M.G. Bernardo-Gil, M. Albertina Ribeiro, Vapor-liquid equilibria of binary mixtures of  $\beta$ -pinene with limonene and p-cymene at atmospheric pressure, *Fluid Phase Equilibria* 85 (1993) 153–160, doi:10.1016/0378-3812(93)80010-K.
- [1610] J. Dojcansky, J. Heinrich, J. Surovy, *Chem Zvesti.* 22 (1968) 514–520.
- [1611] A. Sander, H. Wagner, *Priv. Commun.* (1987) (n.d.).
- [1612] B. Marongiu, S. Porcedda, B. Pittau, H.V. Kehiaian, Thermodynamics of binary mixtures containing linear or cyclic alkenes. II. Mixtures with benzene or tetrachloromethane, *Fluid Phase Equilibria* 99 (1994) 185–198, doi:10.1016/0378-3812(94)80030-8.
- [1613] V. Vostrikova, T. Komarova, M. Aerov, *JAppl Chem USSR* 48 (1975) 960–961.
- [1614] F. Comelli, R. Francesconi, Isobaric vapor-liquid equilibrium in binary mixtures of m- and p-xylenes with cyclohexene and cyclohexanone, *Can. J. Chem. Eng.* 63 (1985) 344–347, doi:10.1002/cjce.5450630225.
- [1615] V. Afanas'ev, A. Demidov, A. Grishunin, *Deposited Doc Onitexkhim* (1984) 1–16.
- [1616] N. Karaseva, A. Karavaeva, T. Antonova, *Izv Vyssh Uchebn Zaved Khim Khim Tekhnol* 40 (1997) 18–20.
- [1617] S. Raeissi, C.J. Peters, Experimental determination of high-pressure phase equilibria of the ternary system carbon dioxide+limonene+linalool, *J. Supercrit. Fluids.* 35 (2005) 10–17, doi:10.1016/j.supflu.2004.12.004.
- [1618] T. Gamse, R. Marr, High-pressure phase equilibria of the binary systems carvone-carbon dioxide and limonene-carbon dioxide at 30, 40 and 50°C, *Fluid Phase Equilibria* 171 (2000) 165–174, doi:10.1016/S0378-3812(00)00353-8.
- [1619] A. Berna, A. Cháfer, J.B. Montón, Solubilities of Essential Oil Components of Orange in Supercritical Carbon Dioxide, *J. Chem. Eng. Data.* 45 (2000) 724–727, doi:10.1021/je9903101.
- [1620] G. Di Giacomo, V. Brandani, G. Del Re, V. Mucciante, Solubility of essential oil components in compressed supercritical carbon dioxide, *Fluid Phase Equilibria* 52 (1989) 405–411, doi:10.1016/0378-3812(89)80346-2.
- [1621] Y. Iwai, T. Morotomi, K. Sakamoto, Y. Koga, Y. Arai, High-Pressure Vapor-Liquid Equilibria for Carbon Dioxide + Limonene, *J. Chem. Eng. Data.* 41 (1996) 951–952, doi:10.1021/je9600055.
- [1622] M. Akgün, N.A. Akgün, S. Dinçer, Phase behaviour of essential oil components in supercritical carbon dioxide: Partial results of this work were presented at the NATO-ASI Supercritical Fluids. II. Fundamentals and Applications, Kemer, Turkey, 1998.1, *J. Supercrit. Fluids.* 15 (1999) 117–125, doi:10.1016/S0896-8446(99)00006-6.
- [1623] Ph. Marteau, J. Obriot, R. Tufeu, Experimental determination of vapor-liquid equilibria of CO<sub>2</sub> + limonene and CO<sub>2</sub> + citral mixtures, *J. Supercrit. Fluids.* 8 (1995) 20–24, doi:10.1016/0896-8446(95)90046-2.
- [1624] S.a.B.V.D. Melo, P. Pallado, G.B. Guarise, A. Bertucco, High-pressure vapor-liquid equilibrium data for binary and ternary systems formed by supercritical CO<sub>2</sub>, limonene and linalool, *Braz. J. Chem. Eng.* 16 (1999) 7–17, doi:10.1590/S0104-66321999000100002.
- [1625] J. Pavlíček, M. Richter, High pressure vapour-liquid equilibrium in the carbon dioxide –  $\alpha$ -pinene system, *Fluid Phase Equilibria* 90 (1993) 125–133, doi:10.1016/0378-3812(93)85007-9.
- [1626] M. Richter, H. Sovová, The solubility of two monoterpenes in supercritical carbon dioxide, *Fluid Phase Equilibria* 85 (1993) 285–300, doi:10.1016/0378-3812(93)80020-N.
- [1627] H.A. Matos, E.G. De Azevedo, P.C. Simoes, M.T. Carrondo, M.N. Da Ponte, Phase equilibria of natural flavours and supercritical solvents, *Fluid Phase Equilibria* 52 (1989) 357–364, doi:10.1016/0378-3812(89)80341-3.
- [1628] G.A. Leeke, R. Santos, M.B. King, Vapor-Liquid Equilibria for the Carbon Dioxide + Carvacrol System at Elevated Pressures, *J. Chem. Eng. Data.* 46 (2001) 541–545, doi:10.1021/je000342k.
- [1629] F. Benvenuti, F. Gironi, High-pressure equilibrium data in systems containing supercritical carbon dioxide, limonene, and citral, *J. Chem. Eng. Data.* 46 (2001) 795–799, doi:10.1021/je000160q.
- [1630] E.G. De Azevedo, H.A. Matos, M.N. Da Ponte, Phase equilibria of ethene + limonene and ethene + cineole from 285 k to 308 k and pressures to 8 mpa, *Fluid Phase Equilibria* 83 (1993) 193–202, doi:10.1016/0378-3812(93)87022-S.
- [1631] E. Siimer, M. Kuus, L. Kudryavtseva, Excess enthalpies of systems containing unsaturated hydrocarbons by unifac group contribution, *Thermochim. Acta.* 209 (1992) 103–110, doi:10.1016/0040-6031(92)80188-3.
- [1632] L. Kudryavtseva, E. Siimer, Excess enthalpies of 1-nonene-n-nonane, 1-hexanol-2-hexyn-1-ol, 1-nonene- 2-hexyn-1-ol-n-nonane, and 1-hexanol-2-hexyn-1-ol-n-nonane at 298.15 K, *Thermochim. Acta.* 237 (1994) 43–47, doi:10.1016/0040-6031(94)85182-4.
- [1633] G. Delmas, T. Nguyen, Correlation of orientations in chain molecules in the liquid state: heats of mixing for dodecanol, dodecyl chloride, 1-dodecene and 1-decene with four normal and four branched alkanes, *J Chim Phys Phys-Chim Biol* 72 (1975) 1285–1290.
- [1634] W. Wóycicki, Excess enthalpies of binary mixtures containing unsaturated hydrocarbons, *J. Chem. Thermodyn.* 16 (1984) 219–224, doi:10.1016/0021-9614(84)90082-X.
- [1635] K. Fischer, J. Gmehling, Vapor-liquid equilibria, activity coefficients at infinite dilution and heats of mixing for mixtures of N-methyl pyrrolidone-2 with

- C5 or C6 hydrocarbons and for hydrocarbon mixtures, *Fluid Phase Equilibria* 119 (1996) 113–130, doi:10.1016/0378-3812(95)02983-4.
- [1636] T.M. Letcher, R.C. Baxter, Excess enthalpies and excess volumes of (a bicyclic compound + 1-hexene or 1-hexyne or 1-heptene or 1-heptyne) at 298.15 K, *J. Chem. Thermodyn.* 20 (1988) 39–47, doi:10.1016/0021-9614(88)90208-x.
- [1637] T.M. Letcher, R.C. Baxter, Excess enthalpies of binary mixtures for 1,3-cyclohexadiene and 1,4-cyclohexadiene + cyclohexane, + n-hexane and + benzene, *Thermochim. Acta.* 102 (1986) 245–248, doi:10.1016/0040-6031(86)85331-X.
- [1638] T.M. Letcher, R.C. Baxter, Excess enthalpies and excess volumes of (a bicyclic compound + cyclohexene or 1,3-cyclohexadiene or 1,4-cyclohexadiene) at 298.15 K, *J. Chem. Thermodyn.* 20 (1988) 149–157, doi:10.1016/0021-9614(88)90150-4.
- [1639] D.-K. Liao, X.-L. Meng, Z.-F. Tong, D.-X. Zheng, D.-Y. Peng, B.C.-Y. Lu, Excess Molar Enthalpies of p-Cymene +  $\alpha$ -Pinene +  $\beta$ -Pinene at (298.15, 308.15, and 318.15) K and at Atmospheric Pressure, *J. Chem. Eng. Data.* 52 (2007) 808–811, doi:10.1021/je060420p.
- [1640] W. Brooks, J. McKetta, The solubility of 1-butene in water, *Pet Refin* 34 (1955) 143–144.
- [1641] W. Brooks, J. McKetta, The solubility of water in 1-butene, *Pet Refin* 34 (1955) 138.
- [1642] W. Brooks, J. Haughn, J. McKetta, The 1-butene-water system in the vapor and three-phase regions, *Pet Refin* 34 (1955) 129–130.
- [1643] H. Josten, Ph.D. thesis, RWTH Aachen, 1986, pp. 1–244.
- [1644] C.D. Reed, J.J. McKetta, Solubility of 1,3-Butadiene in Water, *J. Chem. Eng. Data.* 4 (1959) 294–295, doi:10.1021/je60004a002.
- [1645] G. Liu, Y. Ren, Z. Mi, Measurement and Correlation of Solubility for Propylene in 2-Propanol-Water Solutions, *Chemweb Preprint Server* (2002) 1–5 (n.d.).
- [1646] C.C. Li, J.J. McKetta, Vapor-liquid equilibrium in the propylene-water system, *J. Chem. Eng. Data.* 8 (1963) 271–275, doi:10.1021/je60017a040.
- [1647] X. Chen, X. Xu, Phase equilibria of propylene-methanol-water system, *Huagong Xuebao Chin Ed* 49 (1998) 632–638.
- [1648] M. Sanchez, H. Lentz, Phase equilibrium of water-propene and water-ethene systems at high temperatures and pressures, 5, *High Temp-High Press*, 1973, pp. 689–699.
- [1649] A. Azarnoosh, J.J. McKetta, Solubility of Propylene in Water, *J. Chem. Eng. Data.* 4 (1959) 211–212, doi:10.1021/je60003a006.
- [1650] N.M. Lancaster, C.J. Wormald, Excess molar enthalpies for  $\{x\text{H}_2\text{O} + (1-x)\text{C}_3\text{H}_6\}$ (g),  $\{x\text{H}_2\text{O} + (1-x)\text{C}_3\text{H}_8\}$ (g), and  $\{x\text{H}_2\text{O} + (1-x)\text{C}_4\text{H}_{10}\}$ (g), *J. Chem. Thermodyn.* 18 (1986) 545–550, doi:10.1016/0021-9614(86)90137-0.
- [1651] W.L. Burriss, N.T. Hsu, H.H. Reamer, B.H. Sage, Phase Behavior of the Hydrogen-Propane System, *Ind. Eng. Chem.* 45 (1953) 210–213, doi:10.1021/ie50517a060.
- [1652] D.B. Trust, F. Kurata, Vapor-liquid phase behavior of the hydrogen-propane and hydrogen-carbon monoxide-propane systems, *AIChE J* 17 (1971) 86–91, doi:10.1002/aic.690170119.
- [1653] P. Bol'shakov, L. Linshits, Phase equilibria liquid-gas systems at high pressures, *Tr GIAP* 3 (1954) 18–27.
- [1654] R.B. Williams, D.L. Katz, Vapor-liquid equilibria in binary systems. hydrogen with ethylene, ethane, propylene, and propane, *Ind. Eng. Chem.* 46 (1954) 2512–2520, doi:10.1021/ie50540a033.
- [1655] H.J. Aroyan, D.L. Katz, Low temperature vapor-liquid equilibria in hydrogen-n-butane system, *Ind. Eng. Chem.* 43 (1951) 185–189, doi:10.1021/ie50493a050.
- [1656] E.E. Nelson, W.S. Bonnell, Solubility of hydrogen in n-butane, *Ind. Eng. Chem.* 35 (1943) 204–206, doi:10.1021/ie50398a016.
- [1657] D. Augood, The separation of HD and H2 by absorptive fractionation, *Trans. Inst. Chem. Eng.* 35 (1957) 394–408.
- [1658] A.E. Klink, H.Y. Cheh, E.H. Amick, The vapor-liquid equilibrium of the hydrogen-n-butane system at elevated pressures, *AIChE J* 21 (1975) 1142–1148, doi:10.1002/aic.690210614.
- [1659] J.F. Connolly, G.A. Kandalic, Gas solubilities, vapor-liquid equilibria, and partial molal volumes in some hydrogen-hydrocarbon systems, *J. Chem. Eng. Data.* 31 (1986) 396–406, doi:10.1021/je00046a008.
- [1660] N.P. Freitag, D.B. Robinson, Equilibrium phase properties of the hydrogen-methane-carbon dioxide, hydrogen-carbon dioxide-n-pentane and hydrogen-n-pentane systems, *Fluid Phase Equilibria* 31 (1986) 183–201, doi:10.1016/0378-3812(86)90012-9.
- [1661] W.B. Nichols, H.H. Reamer, B.H. Sage, Volumetric and phase behavior in the hydrogen-n-hexane system, *AIChE J* 3 (1957) 262–267, doi:10.1002/aic.690030223.
- [1662] E. Brunner, Solubility of hydrogen in 10 organic solvents at 298.15, 323.15, and 373.15 K, *J. Chem. Eng. Data.* 30 (1985) 269–273, doi:10.1021/je00041a010.
- [1663] W. Gao, R.L. Robinson, K.A.M. Gasem, Solubilities of Hydrogen in Hexane and of Carbon Monoxide in Cyclohexane at Temperatures from 344.3 to 410.9 K and Pressures to 15 MPa, *J. Chem. Eng. Data.* 46 (2001) 609–612, doi:10.1021/je0003546.
- [1664] M.-S. Fu, C.-S. Tan, Solubility of hydrogen in a mixture of n-hexane and dicyclopentadiene from 313 to 363 K and from 2.0 to 5.5 MPa, *Fluid Phase Equilibria* 93 (1994) 233–247, doi:10.1016/0378-3812(94)87011-X.
- [1665] S. Peter, Phase Equilibrium in the Systems H<sub>2</sub>-n-Heptane, H<sub>2</sub>-Methyl Cyclohexane, and H<sub>2</sub>-2, 2, 4-Trimethyl Pentane at Elevated Pressures and Temperatures, *Z Phys. Chemm Frankf.* 24 (1960) 103–118.
- [1666] M.W. Cook, D.N. Hanson, B.J. Alder, Solubility of Hydrogen and Deuterium in Nonpolar Solvents, *J. Chem. Phys.* 26 (1957) 748–751, doi:10.1063/1.1743398.
- [1667] S.K. Lachowicz, D.M. Newitt, K.E. Weale, The solubility of hydrogen and deuterium in n-heptane and n-octane at high pressures, *Trans. Faraday Soc.* 51 (1955) 1198–1205, doi:10.1039/TF9555101198.
- [1668] R. Ene, I. Bica, D. Sandulescu, Determination of hydrogen solubility in liquid hydrocarbons at atmospheric pressure, *Rev. Roum. Chim.* 27 (1982) 609–613.
- [1669] J. Connolly, Vapor-liquid equilibrium ratios for four binary systems, *Proc. Am. Pet. Inst. Sect. III.* 45 (1965) 62–67.
- [1670] J.F. Connolly, G.A. Kandalic, Thermodynamic properties of solutions of hydrogen in n-octane, *J. Chem. Thermodyn.* 21 (1989) 851–858, doi:10.1016/0021-9614(89)90033-5.
- [1671] K.J. Kim, T.R. Way, K.T. Feldman, A. Razani, Solubility of Hydrogen in Octane, 1-Octanol, and Squallane, *J. Chem. Eng. Data.* 42 (1997) 214–215, doi:10.1021/je960268z.
- [1672] V. Sokolov, A. Polyakov, Solubility of hydrogen in n-decane, n-tetradecane, 1-hexene, 1-pentene, 4-octene, isopropylbenzene, 1-methylnaphthalene, and decalin, *J. Appl. Chem. USSR.* 50 (1977) 1347–1349.
- [1673] H.M. Sebastian, J.J. Simnick, H.-M. Lin, K.-C. Chao, Gas-liquid equilibrium in the hydrogen + n-decane system at elevated temperatures and pressures, *J. Chem. Eng. Data.* 25 (1980) 68–70, doi:10.1021/je60084a021.
- [1674] J. Park, R.L. Robinson, K.A.M. Gasem, Solubilities of Hydrogen in Heavy Normal Paraffins at Temperatures from 323.2 to 423.2 K and Pressures to 17.4 MPa, *J. Chem. Eng. Data.* 40 (1995) 241–244, doi:10.1021/je00017a051.
- [1675] B.A. Schofield, Z.E. Ring, R.W. Missen, Solubility of hydrogen in a white oil, *Can. J. Chem. Eng.* 70 (1992) 822–824, doi:10.1002/cjce.5450700431.
- [1676] L.J. Florusse, C.J. Peters, J.C. Pàmies, L.F. Vega, H. Meijer, Solubility of hydrogen in heavy n-alkanes: Experiments and soft modeling, *AIChE J* 49 (2003) 3260–3269, doi:10.1002/aic.690491225.
- [1677] M.R. Dean, J.W. Tooke, Vapor-Liquid Equilibria in Three Hydrogen-Paraffin Systems, *Ind. Eng. Chem.* 38 (1946) 389–393, doi:10.1021/ie50436a014.
- [1678] R. Dohrn, G. Brunner, Phase equilibria in ternary and quaternary systems of hydrogen, water and hydrocarbons at elevated temperatures and pressures, *Fluid Phase Equilibria* 29 (1986) 535–544, doi:10.1016/0378-3812(86)85052-X.
- [1679] S.H. Huang, H.M. Lin, F.N. Tsai, K.C. Chao, Solubility of synthesis gases in heavy n-paraffins and Fischer-Tropsch wax, *Ind. Eng. Chem. Res.* 27 (1988) 162–169, doi:10.1021/ie00073a030.
- [1680] S. Laugier, D. Richon, H. Renon, Vapor-liquid equilibria of hydrogen-2,2,4-trimethylpentane and hydrogen-toluene systems at high pressures and temperatures, *J. Chem. Eng. Data.* 25 (1980) 274–276, doi:10.1021/je60086a019.
- [1681] J. Hong, R. Kobayashi, Vapor liquid equilibrium study of the H<sub>2</sub>-CH<sub>4</sub> system at low temperatures and elevated pressures, *Gas Process. Assoc. Res. Rep.* 46 (1980) 1–25.
- [1682] C.Y. Tsang, P. Clancy, J.C.G. Calado, W.B. Streett, Phase equilibria in the H<sub>2</sub>/CH<sub>4</sub> system at temperatures from 92.3 to 180.0 K and pressures to 140 MPa, *Chem. Eng. Commun.* 6 (1980) 365–383, doi:10.1080/00986448008912543.
- [1683] M. Yorizane, S. Yoshimura, H. Masuoka, A. Toyama, Low temperature vapour-liquid equilibria of hydrogen-containing binaries, in: *Proc 1st Int Cryog Eng Conf*, 1968, pp. 57–62.
- [1684] J.H. Hong, R. Kobayashi, Vapor-liquid equilibrium study of the hydrogen-methane system at low temperatures and elevated pressures, *J. Chem. Eng. Data.* 26 (1981) 127–131, doi:10.1021/je00024a007.
- [1685] A.L. Benham, D.L. Katz, Vapor-liquid equilibria for hydrogen-light-hydrocarbon systems at low temperatures, *AIChE J* 3 (1957) 33–36, doi:10.1002/aic.690030107.
- [1686] V. Fastovskii, M. Gonikberg, Solubility of gases in liquids at low temperatures and high pressures. III. solubility of hydrogen in liquid methane, *Acta Physicochim. URSS.* 12 (1940) 485–488.
- [1687] M. Yorizane, S. Yoshimura, H. Masuoka, I. Funada, C.-T. Fu, B.C.-Y. Lu, Phase Behavior of Three Hydrogen-Containing Ternary Systems, in: K.D. Timmerhaus, H.A. Snyder (Eds.), *Adv. Cryog. Eng.*, Springer US, Boston, MA, 1980, pp. 654–661, doi:10.1007/978-1-4613-9856-1\_75.
- [1688] B. Kirk, W. Ziegler, A phase-equilibrium apparatus for gas-liquid systems and the gas phase of gas-solid systems: application to methane-hydrogen from 66.88° to 116.53°K and up to 125 atmospheres, *Adv. Cryog. Eng.* 10 (1965) 160–170.
- [1689] A. Heintz, W.B. Streett, Phase equilibria in the hydrogen/ethane system at temperatures from 92.5 to 280.1 K and pressures to 560 MPa, *J. Chem. Eng. Data.* 27 (1982) 465–469, doi:10.1021/je00030a029.
- [1690] A. Cohen, H. Hipkin, C. Koppány, Experimental vapor-liquid equilibrium data for hydrogen-ethane and hydrogen-methane-ethane, *Chem. Eng. Prog. Symp. Ser.* 63 (1967) 10–17.
- [1691] M.J. Hiza, C.K. Heck, A.J. Kidnay, Liquid-Vapor and Solid-Vapor Equilibrium in the System Hydrogen-Ethane, in: K.D. Timmerhaus (Ed.), *Adv. Cryog. Eng.*, Springer US, 1995, pp. 343–356.
- [1692] V. Ipat'ev, V. Teodorovich, A. Brestkin, The region of ultrahigh pressures. I. The equilibrium between the liquid and the vapor phases in the system hydrogen-benzene at pressures up to 3000 atmospheres, *Zhurnal Fiz. Khimii.* 22 (1948) 833–845.
- [1693] J.F. Connolly, Thermodynamic Properties of Hydrogen in Benzene Solutions, *J. Chem. Phys.* 36 (1962) 2897–2904, doi:10.1063/1.1732399.
- [1694] J. Park, R.L. Robinson, K.A.M. Gasem, Solubilities of Hydrogen in Aromatic Hydrocarbons from 323 to 433 K and Pressures to 21.7 MPa, *J. Chem. Eng. Data.* 41 (1996) 70–73, doi:10.1021/je950152n.



- [1695] V. Ipat'ev Jr., M. Levin, Equilibrium between liquid and gas at high pressures and temperatures. I. solubility of hydrogen in individual hydrocarbons of the aromatic and the naphthenic series, *Zhurnal Fiz. Khimii*. 6 (1935) 632–639.
- [1696] R.E. Thompson, W.C. Edmister, Vapor-liquid equilibria in hydrogen-benzene and hydrogen-cyclohexane mixtures, *AIChE J* 11 (1965) 457–461, doi:10.1002/aic.690110318.
- [1697] K. Chao, H. Lin, K. Liu, Phase equilibrium in coal liquefaction processes, *Research Project 367-1, Electric Power Research Institute AF-466* (1976) 1–87 (n.d.).
- [1698] A.J. Brainard, B. Williams, Vapor-liquid equilibria for the system hydrogen-benzene-cyclohexane-n-hexane, *AIChE J* 13 (1967) 60–69, doi:10.1002/aic.690130113.
- [1699] J.J. Simnick, C.C. Lawson, H.M. Lin, K.C. Chao, Vapor-liquid equilibrium of hydrogen/tetralin system at elevated temperatures and pressures, *AIChE J* 23 (1977) 469–476, doi:10.1002/aic.690230410.
- [1700] J.J. Simnick, K.D. Liu, H.-M. Lin, K.-C. Chao, Gas-liquid equilibrium in mixtures of hydrogen and diphenylmethane, *Ind. Eng. Chem. Process Des. Dev.* 17 (1978) 204–208, doi:10.1021/i260066a015.
- [1701] M.B. King, H. Al-Najjar, The solubilities of carbon dioxide, hydrogen sulphide and propane in some normal alkane solvents—I. Experimental determinations in the range 15–70°C and comparison with ideal solution values, *Chem. Eng. Sci.* 32 (1977) 1241–1246, doi:10.1016/0009-2509(77)80059-6.
- [1702] H.-J. Ng, H. Kalra, D.B. Robinson, H. Kubota, Equilibrium phase properties of the toluene-hydrogen sulfide and heptane-hydrogen sulfide binary systems, *J. Chem. Eng. Data*. 25 (1980) 51–55, doi:10.1021/je60084a020.
- [1703] B. Eakin, W. DeVaney, Vapor-liquid equilibrium in hydrogen-hydrogen sulfide-carbon-9 hydrocarbon systems, *AIChE Symp. Ser.* 70 (1974) 80–90.
- [1704] H.H. Reamer, F.T. Selleck, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. Volumetric and Phase Behavior of Decane-Hydrogen Sulfide System, *Ind. Eng. Chem.* 45 (1953) 1810–1812, doi:10.1021/ie50524a055.
- [1705] C. Yokoyama, A. Usui, S. Takahashi, Solubility of hydrogen sulfide in isooctane, n-decane, n-tridecane, n-hexadecane and squalane at temperatures from 323 to 523 K and pressures up to 1.6 MPa, *Fluid Phase Equilibria* 85 (1993) 257–269, doi:10.1016/0378-3812(93)80018-1.
- [1706] G.-X. Feng, A.E. Mather, Solubility of H<sub>2</sub>S in n-dodecane, *Fluid Phase Equilibria* 87 (1993) 341–346, doi:10.1016/0378-3812(93)85035-K.
- [1707] G.-X. Feng, A.E. Mather, Solubility of H<sub>2</sub>S in n-hexadecane at elevated pressure, *Can. J. Chem. Eng.* 71 (1993) 327–328, doi:10.1002/cjce.5450710221.
- [1708] G.J. Besserer, D.B. Robinson, The equilibrium phase properties of the i-butane-hydrogen sulfide system, *J. Chem. Eng. Jpn.* 8 (1975) 11–15, doi:10.1252/jcej.8.11.
- [1709] D. Robinson, G. Besserer, The Equilibrium Phase Properties of the Binary Systems: Nitrogen-Hydrogen Sulfide, Isobutane-Hydrogen Sulfide, Isobutane-Carbon Dioxide, Isobutane-Ethane; Gas Processors Association, *Research Report RR-7*, 1972, (n.d.).
- [1710] A.D. Leu, D.B. Robinson, High-pressure vapor-liquid equilibrium phase properties of the isopentane-hydrogen sulfide and neopentane-hydrogen sulfide binary systems, *J. Chem. Eng. Data*. 37 (1992) 14–17, doi:10.1021/je00005a005.
- [1711] N.L. Yarym-Agaev, L.D. Afanasenko, V.G. Matvienko, Y.Y. Ryabkin, G.B. Tolmacheva, Gas-liquid equilibrium in the methane-hydrogen sulfide system below 273 K, *Ukr Khim Zh Russ Ed* 57 (1991) 701–704.
- [1712] J.P. Kohn, F. Kurata, Volumetric Behavior of the Methane-Hydrogen Sulfide System at Low Temperatures and High Pressures, *J. Chem. Eng. Data*. 4 (1959) 33–36, doi:10.1021/je60001a005.
- [1713] J.P. Kohn, F. Kurata, Heterogeneous phase equilibria of the methane-hydrogen sulfide system, *AIChE J* 4 (1958) 211–217, doi:10.1002/aic.690040217.
- [1714] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. Volumetric and Phase Behavior of the Methane-Hydrogen Sulfide System, *Ind. Eng. Chem.* 43 (1951) 976–981, doi:10.1021/ie50496a052.
- [1715] J. Morris, C. Byers, Critical-region Vapor-liquid equilibrium of the methane-carbon dioxide-hydrogen sulfide system; Oak Ridge National Laboratory Report ORNL/TM-10806, 1990, (n.d.).
- [1716] A.O. Barry, S.C. Kaliaguine, R.S. Ramalho, Excess enthalpies of the binary system methane-hydrogen sulfide by flow calorimetry, *J. Chem. Eng. Data*. 27 (1982) 436–439, doi:10.1021/je00030a020.
- [1717] D.B. Robinson, A.P. Lorenzo, C.A. Macrygeorgos, The carbon dioxide-hydrogen sulphide-methane system: Part II. Phase behavior at 40°F. and 160°F. *Can. J. Chem. Eng.* 37 (1959) 212–217, doi:10.1002/cjce.5450370603.
- [1718] A. Kreglewski, K.R. Hall, Phase equilibria calculated for the systems N<sub>2</sub>+CO<sub>2</sub>, CH<sub>4</sub>+CO<sub>2</sub> and CH<sub>4</sub>+H<sub>2</sub>S, *Fluid Phase Equilibria* 15 (1983) 11–32, doi:10.1016/0378-3812(83)80020-X.
- [1719] F. Rivollet, C. Jarne, D. Richon, P<sub>o</sub>T and VLE for Ethane+Hydrogen Sulfide from (254.05 to 363.21) K at Pressures up to 20 MPa, *J. Chem. Eng. Data*. 50 (2005) 1883–1890, doi:10.1021/je050157c.
- [1720] H. Kalra, D.B. Robinson, T.R. Krishnan, The equilibrium phase properties of the ethane-hydrogen sulfide system at subambient temperatures, *J. Chem. Eng. Data*. 22 (1977) 85–88, doi:10.1021/je60072a005.
- [1721] W.B. Kay, D.B. Brice, Liquid-Vapor Equilibrium Relations in Ethane-Hydrogen Sulfide System, *Ind. Eng. Chem.* 45 (1953) 615–618, doi:10.1021/ie50519a042.
- [1722] K. Fischer, J. Chen, M. Petri, J. Gmehling, Solubility of H<sub>2</sub>S and CO<sub>2</sub> in N-octyl-2-pyrrolidone and of H<sub>2</sub>S in methanol and benzene, *AIChE J* 48 (2002) 887–893, doi:10.1002/aic.690480422.
- [1723] S.S.-S. Huang, D.B. Robinson, Vapor-liquid equilibrium in selected aromatic binary systems: m-xylene-hydrogen sulfide and mesitylene-hydrogen sulfide, *Fluid Phase Equilibria* 17 (1984) 373–382, doi:10.1016/0378-3812(84)85006-2.
- [1724] D.S. Tsiklis, G.M. Svetlova, *Zh. Fiz. Khim.* 32 (1958) 1–12.
- [1725] J.A. Bierlein, W.B. Kay, Phase-Equilibrium Properties of System Carbon Dioxide-Hydrogen Sulfide, *Ind. Eng. Chem.* 45 (1953) 618–624, doi:10.1021/ie50519a043.
- [1726] D.P. Sobocinski, F. Kurata, Heterogeneous phase equilibria of the hydrogen sulfide-carbon dioxide system, *AIChE J* 5 (1959) 545–551, doi:10.1002/aic.690050425.
- [1727] C.E. Stouffer, S.J. Kellerman, K.R. Hall, J.C. Holste, B.E. Gammon, K.N. Marsh, Densities of carbon dioxide + hydrogen sulfide mixtures from 220 K to 450 K at pressures up to 25 MPa, *J. Chem. Eng. Data*. 46 (2001) 1309–1318, doi:10.1021/je000182c.
- [1728] G.J. Besserer, D.B. Robinson, Equilibrium-phase properties of nitrogen-hydrogen sulfide system, *J. Chem. Eng. Data*. 20 (1975) 157–161, doi:10.1021/je60065a006.
- [1729] G. Wilson, J. Cunningham, P. Nielsen, Enthalpy and Phase Boundary Measurements on Mixtures of Nitrogen with Methane, Carbon Dioxide and Hydrogen Sulfide, *Gas Process. Assoc. Res. Rep.* RR-24 (1977) (n.d.).
- [1730] D. Zudkevitch, G. Wilson, *Proc Annu. Conv. – Gas Process. Assoc.* 53 (1974) 101–103.
- [1731] R.L. Denyer, F.A. Fidler, R.A. Lowry, Azeotrope formation between thiols and hydrocarbons, *Ind. Eng. Chem.* 41 (1949) 2727–2737, doi:10.1021/ie50480a018.
- [1732] J. Kilner, S.E. McBain, M.G. Roffey, Vapor+liquid equilibria of (methanethiol or ethanethiol or propan-1-thiol or butan-1-thiol+ n-hexane or n-decane or toluene or water) for mole fractions x=0 to 0.2 of thiol at temperatures between 323 and 373 K, *J. Chem. Thermodyn.* 22 (1990) 203–210, doi:10.1016/0021-9614(90)90084-4.
- [1733] H. Wolff, J. Szydłowski, L. Dill-Staffenberger, Vapor-liquid equilibria of deuterioisomeric methanethiols and their mixtures with n-hexane, *J. Chem. Thermodyn.* 12 (1980) 641–652, doi:10.1016/0021-9614(80)90086-5.
- [1734] W. Eng, PhD Thesis, Brigham Young University, Salt Lake, 1977.
- [1735] N.F. Giles, G.M. Wilson, Phase Equilibria on Seven Binary Mixtures, *J. Chem. Eng. Data*. 45 (2000) 146–153, doi:10.1021/je990221o.
- [1736] R. Shakirzyanov, E. Telyakov, L. Serafimov, *Z Prikl. Khimii St., Peterburg Russ. Fed.* 55 (1982) 1041–1044.
- [1737] R.G. Shakirzyanov, E.Sh. Telyakov, M.G. Ibragimov, L.A. Serafimov, *Zh. Prikl. Khim.* 54 (1981) 1021–1023.
- [1738] N.F. Giles, L.C. Wilson, G.M. Wilson, W.V. Wilding, Phase Equilibria on Eight Binary Mixtures, *J. Chem. Eng. Data*. 42 (1997) 1067–1074, doi:10.1021/je970028z.
- [1739] T.M. Letcher, B.C. Bricknell, Calorimetric investigation of the interactions of some hydrogen-bonded systems at 298.15 K, *J. Chem. Eng. Data*. 41 (1996) 166–169, doi:10.1021/je9501806.
- [1740] G.C. Allred, J.W. Beets, W.R. Parrish, Excess Properties for 1-Butanethiol+Heptane, +Cyclohexane, +Benzene, and +Toluene. 2. Excess Molar Enthalpies at 283.15, 298.15, and 333.15 K, *J. Chem. Eng. Data*. 40 (1995) 1062–1066, doi:10.1021/je00021a007.
- [1741] P. Guilbot, K. Fischer, A. Valtz, P. Théveneau, A. Baba-Ahmed, D. Richon, Measurement of VLE (TPx or TPxy data) for hydrogen sulfide+(dimethylsulfide or ethylmethylsulfide or carbon disulfide) and methane solubilities in (dimethylsulfide or ethylmethylsulfide or methylmercaptan or ethylmercaptan), *Fluid Phase Equilibria* 260 (2007) 49–59, doi:10.1016/j.fluid.2007.07.013.
- [1742] J. McNelis, K. Wileman, B. Poling, *AIChE Symp Ser* 85 (1989) 87–93.
- [1743] J.I. Lee, A.E. Mather, F.D. Otto, Vapor-liquid equilibria in the system hydrogen sulfide-methanethiol, *J. Chem. Eng. Data*. 23 (1978) 78–79, doi:10.1021/je60076a015.
- [1744] J.A. Awan, I. Tsvintzelis, M.P. Breil, C. Coquelet, D. Richon, G.M. Kontogeorgis, Phase Equilibria of Mixtures Containing Organic Sulfur Species (OSS) and Water/Hydrocarbons: VLE Measurements and Modeling Using the Cubic-Plus-Association Equation of State, *Ind. Eng. Chem. Res.* 49 (2010) 12718–12725, doi:10.1021/ie101470b.
- [1745] S. Umamo, Y. Nakano, Solubility of propane and butane in salt solution, *Kogyo Kagaku Zasshi* 61 (1958) 536–542.
- [1746] R. Kobayashi, D. Katz, Vapor-Liquid Equilibria For Binary Hydrocarbon-Water Systems, *Ind. Eng. Chem.* 45 (1953) 440–446, doi:10.1021/ie50518a051.
- [1747] A.H. Wehe, J.J. McKetta, Method for Determining Total Hydrocarbons Dissolved in Water, *Anal. Chem.* 33 (1961) 291–293, doi:10.1021/ac60170a042.
- [1748] A. Azarnooch, J. McKetta, The Solubility of Propane in Water, *Pet Refin* 37 (1958) 275–278.
- [1749] M. Sanchez, R. Coll, Propane-water system at high pressures and temperatures. I. Two-phase region, *Quim 74* (1978) 1329–1335.
- [1750] N. Klausitis, Thesis, University of Texas at Austin, 1968, pp. 1–113.
- [1751] A. Chapoy, S. Mokraoui, A. Valtz, D. Richon, A.H. Mohammadi, B. Tohidi, Solubility measurement and modeling for the system propane-water from 277.62 to 368.16K, *Fluid Phase Equilibria* 226 (2004) 213–220, doi:10.1016/j.fluid.2004.08.040.
- [1752] Th.W.De Loos, A.J.M. Wijen, G.A.M. Diepen, Phase equilibria and critical phenomena in fluid (propane+water) at high pressures and temperatures, *J. Chem. Thermodyn.* 12 (1980) 193–204, doi:10.1016/0021-9614(80)90130-5.
- [1753] S.T. Blanco, I. Velasco, E. Rauzy, S. Otiñ, Water dew points of binary nitrogen+water and propane+water mixtures. measurement and correla-

- tion, *Fluid Phase Equilibria* 161 (1999) 107–117, doi:10.1016/S0378-3812(99)00164-8.
- [1754] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase equilibria in hydrocarbon systems. n-butane-water system in the two-phase region, *Ind. Eng. Chem.* 44 (1952) 609–615, doi:10.1021/jie50507a049.
- [1755] J.G. Le Breton, J.J. McKetta, Low pressure solubility of n-butane in water, *Hydrocarb. Process Pet Refin.* 43 (1964) 136–138.
- [1756] J.J. Carroll, F.-Y. Jou, A.E. Mather, Fluid phase equilibria in the system n-butane + water, *Fluid Phase Equilibria* 140 (1997) 157–169, doi:10.1016/S0378-3812(97)00199-4.
- [1757] W. Brooks, G. Gibbs, J. McKetta, Mutual Solubilities of Light Hydrocarbon-Water Systems, *Pet Refin* 30 (1951) 118–120.
- [1758] H.H. Reamer, R.H. Olds, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. n-Butane-Water System in Three-Phase Region, *Ind. Eng. Chem.* 36 (1944) 381–383, doi:10.1021/jie50412a024.
- [1759] T. Yiling, T. Michelberger, E.U. Franck, High-pressure phase equilibria and critical curves of (water + n-butane) and (water + n-hexane) at temperatures to 700 K and pressures to 300 MPa, *J. Chem. Thermodyn.* 23 (1991) 105–112, doi:10.1016/S0021-9614(05)80063-1.
- [1760] T. Yiling, Z. Xuofeng, C. Li, Z. Hugang, F. Huafeng, High pressure phase equilibria and critical phenomena of water + iso-butane and water + n-butane systems to 695 K and 306 MPa, *J. Supercrit. Fluids.* 30 (2004) 145–153, doi:10.1016/j.supflu.2003.09.002.
- [1761] F.-Y. Jou, A.E. Mather, Vapor-Liquid-Liquid Locus of the System Pentane + Water, *J. Chem. Eng. Data.* 45 (2000) 728–729, doi:10.1021/je000065h.
- [1762] Th.W.de Loos, J.H.van Dorp, R.N. Lichtenthaler, Phase equilibria and critical phenomena in fluid (n-alkane + water) systems at high pressures and temperatures, *Fluid Phase Equilibria* 10 (1983) 279–287, doi:10.1016/0378-3812(83)80041-7.
- [1763] A. Namiot, V. Skripka, Y. Lotter, Phase Equilibria in Hydrocarbon-Water Systems at High Temperatures, *VINITI Database* (1976) 1213–1276 p 1–13, (n.d.).
- [1764] M.A. Barrufet, K. Liu, S. Rahman, C. Wu, Simultaneous Vapor-Liquid-Liquid Equilibria and Phase Molar Densities of a Quaternary System of Propane + Pentane + Octane + Water, *J. Chem. Eng. Data.* 41 (1996) 918–922, doi:10.1021/je9600616.
- [1765] C.J. Rebert, K.E. Hayworth, The gas and liquid solubility relations in hydrocarbon-water systems, *AIChE J* 13 (1967) 118–121, doi:10.1002/aic.690130122.
- [1766] S.M. Rasulov, A.R. Rasulov, Experimental investigation of the thermal properties of a binary n-hexane-water mixture at high temperatures and pressures, *High Temp.* 38 (2000) 389–393, doi:10.1007/BF02755997.
- [1767] F.E.C. Scheffer, On unmixing in a binary system for which the three-phase pressure is greater than the sum of the vapour tension of the two components, *Proc K Ned Akad Wet Nat Sci* 17 (1914) 834–839.
- [1768] E. Rezanova, A. Toikka, N. Markuzin, Equilibrium of two and three liquid phases with vapor in the n-heptane-nitromethane-water system. I. Experimental data, *Vestn Leningr Univ Ser 4 Fiz Khim* 3 (1991) 53–56.
- [1769] V. Skripka, G. Gubkina, O. Boksha, Phase Equilibria Between n-Alkanes and Water at Elevated Temperatures and Pressures, *VINITI Database* (1973) 7271–7273 p 1–6, (n.d.).
- [1770] R. Sultanov, V. Skripka, Solubility of Water in n-Alkanes at Elevated Temperatures and Pressures, *VINITI Database* (1972) 4372–4386 1–13, (n.d.).
- [1771] C. Brady, J. Cunningham, G. Wilson, Water-Hydrocarbon Liquid-Liquid-Vapor Equilibrium Measurements to 530 degrees F, *GPA Research Report* (1982) RR-62, pp 1–66, (n.d.).
- [1772] M. Tu, D. Fei, Y. Liu, Phase Equilibrium for Partially Miscible System of Octane-Water, *Gaoxiao Huaxue Gongcheng Xuebao* 12 (1998) 325–330.
- [1773] Q. Wang, K.-C. Chao, vapor-liquid and liquid-liquid equilibria and critical states of water + n-decane mixtures, *Fluid Phase Equilibria* 59 (1990) 207–215, doi:10.1016/0378-3812(90)85035-9.
- [1774] M. Haruki, Y. Iwai, S. Nagao, Y. Yahiro, Y. Arai, Measurement and Correlation of Phase Equilibria for Water + Hydrocarbon Systems near the Critical Temperature and Pressure of Water, *Ind. Eng. Chem. Res.* 39 (2000) 4516–4520, doi:10.1021/jie000185i.
- [1775] Q. Wang, G. Chen, S. Han, Critical locus of water-n-decane mixtures, *Shiyou Huagong* 24 (1995) 35–38.
- [1776] R.L. Stevenson, D.S. LaBracio, T.A. Beaton, M.C. Thies, Fluid Phase Equilibria and critical phenomena for the dodecane-water and squalane-water systems at elevated temperatures and pressures, *Fluid Phase Equilibria* 93 (1994) 317–336, doi:10.1016/0378-3812(94)87016-0.
- [1777] C. McAuliffe, Solubility in Water of Paraffin, Cycloparaffin, Olefin, Acetylene, Cycloolefin, and Aromatic Hydrocarbons, *J. Phys. Chem.* 70 (1966) 1267–1275, doi:10.1021/j100876a049.
- [1778] D.B. Watlauffer, S.K. Malik, Leon. Stoller, R.L. Coffin, Nonpolar Group Participation in the Denaturation of Proteins by Urea and Guanidinium Salts. Model Compound Studies, *J. Am. Chem. Soc.* 86 (1964) 508–514, doi:10.1021/ja01057a045.
- [1779] C. Black, G.G. Joris, H.S. Taylor, The Solubility of Water in Hydrocarbons, *J. Chem. Phys.* 16 (1948) 537–543, doi:10.1063/1.1746932.
- [1780] J.F. Connolly, Solubility of Hydrocarbons in Water Near the Critical Solution Temperatures, *J. Chem. Eng. Data.* 11 (1966) 13–16, doi:10.1021/je60028a003.
- [1781] S. Pereda, J.A. Awan, A.H. Mohammadi, A. Valtz, C. Coquelet, E.A. Brignole, D. Richon, Solubility of hydrocarbons in water: Experimental measurements and modeling using a group contribution with association equation of state (GCA-EoS), *Fluid Phase Equilibria* 275 (2009) 52–59, doi:10.1016/j.fluid.2008.09.008.
- [1782] A. Reichl, Measurement and Correlation of the Gas Solubility of Halogenated Hydrocarbons, *Dissertation*, TU Berlin (1996) (n.d.).
- [1783] A. Michels, J. Gerver, A. Bijl, The influence of pressure on the solubility of gases, *Physica* 3 (1936) 797–808, doi:10.1016/S0031-8914(36)80353-X.
- [1784] O.L. Culberson, A.B. Horn, J.J. McKetta, Phase Equilibria in Hydrocarbon-Water Systems, *J. Pet. Technol.* 2 (1950) 1–6, doi:10.2118/950001-G.
- [1785] V. Ugrosov, Equilibrium Compositions of Vapor-Gas Mixtures over Solutions, *Russ. J. Phys. Chem.* 70 (1996) 1240–1241.
- [1786] N. Yarym-Agaev, R. Sinyavskaya, I. Koliushko, Phase Equilibria in the Water-Methane and Methanol-Methane Binary Systems under High Pressures, *J Appl Chem USSR* 58 (1985) 154–157.
- [1787] J.R. Duffy, N.O. Smith, B. Nagy, Solubility of natural gases in aqueous salt solutions—I: Liquidus surfaces in the system CH<sub>4</sub>-H<sub>2</sub>O-NaCl<sub>2</sub>-CaCl<sub>2</sub> at room temperatures and at pressures below 1000 psia, *Geochim. Cosmochim. Acta.* 24 (1961) 23–31, doi:10.1016/0016-7037(61)90004-7.
- [1788] M. Sanchez, M. De, Liquid-vapor equilibrium in the methanol-water system measured at high pressures and temperatures between 150 and 300°C, *Quim* 74 (1978) 1325–1328.
- [1789] O.L. Culberson, J.J. McKetta, Phase Equilibria in Hydrocarbon-Water Systems III – The Solubility of Methane in Water at Pressures to 10,000 PSIA, *J. Pet. Technol.* 3 (1951) 223–226, doi:10.2118/951223-G.
- [1790] R. Sultanov, V. Skripka, A. Namiot, Moisture content of methane at high temperatures and pressures, *Gazov Prom* 16 (1971) 6–8.
- [1791] K. Lekkvam, P.R. Bishnoi, Dissolution of methane in water at low temperatures and intermediate pressures, *Fluid Phase Equilibria* 131 (1997) 297–309, doi:10.1016/S0378-3812(96)03229-3.
- [1792] M. Rigby, J.M. Prausnitz, Solubility of water in compressed nitrogen, argon, and methane, *J. Phys. Chem.* 72 (1968) 330–334, doi:10.1021/j100847a064.
- [1793] P.C. Gillespie, G.M. Wilson, Vapor-Liquid and Liquid-Liquid Equilibria: Water - Methane, Water - Carbon Dioxide, Water - Hydrogen Sulfide, Water - n-Pentane, Water - Methane - n-Pentane, *GPA Res. Rep.* (1982) 1–73.
- [1794] C. Yokoyama, S. Wakana, G. Kaminishi, S. Takahashi, Vapor-liquid equilibria in the methane-diethylene glycol-water system at 298.15 and 323.15 K, *J. Chem. Eng. Data.* 33 (1988) 274–276, doi:10.1021/je00053a015.
- [1795] A. Dhima, Solubilité des gaz naturels dans l'eau à pression élevée, Thesis, University Claude Bernard-Lyon 1 (1998) 1–169 (n.d.).
- [1796] J. Davis, J. McKetta, Solubility of Methane in Water, *Pet Refin* 39 (1960) 205–206.
- [1797] R. Sultanov, V. Skripka, A. Namiot, Solubility of methane in water at high temperatures and pressures, *Gazov Prom* 17 (1972) 6–7.
- [1798] M.B. Malegaonkar, P.D. Dholabhai, P.R. Bishnoi, Kinetics of carbon dioxide and methane hydrate formation, *Can. J. Chem. Eng.* 75 (1997) 1090–1099, doi:10.1002/cjce.5450750612.
- [1799] D. Zheng, J. Gao, D. Sun, Gas solubilities in water/formation water at high temperature and high pressure - an apparatus and its reliability, *Gaoxiao Huaxue Gongcheng Xuebao* 10 (1996) 59–63.
- [1800] R.H. Olds, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. Composition of the Dew-Point Gas of the Methane-Water System, *Ind. Eng. Chem.* 34 (1942) 1223–1227, doi:10.1021/jie50394a018.
- [1801] I. Nagata, Y. Kawamura, H. Asano, K. Fujiwara, Y. Ogasawara, Excess Enthalpies for Binary Mixtures of Chloroform with Alcohols, *Z Phys Chem Leipz* 259 (1978) 1109–1116.
- [1802] K. Tamura, S. Murakami, R. Fujishiro, Excess enthalpies of (cyclohexanone + aromatic hydrocarbon), (methyl cyclohexane + aromatic hydrocarbon), and (methyl cyclohexane + cyclohexanone) at 298.15 K, *J. Chem. Thermodyn.* 13 (1981) 47–52, doi:10.1016/S0021-9614(81)80007-9.
- [1803] Y. Shiohama, H. Ogawa, S. Murakami, I. Fujihara, Excess molar isobaric heat capacities and isentropic compressibilities of (cis- or trans-decalin + benzene or toluene or iso-octane or n-heptane) at 298.15 K, *J. Chem. Thermodyn.* 20 (1988) 1183–1189, doi:10.1016/0021-9614(88)90101-2.
- [1804] Y. Shiohama, H. Ogawa, S. Murakami, I. Fujihara, Molar excess enthalpies of cis-decalin + benzene, + toluene, + isooctane and + heptane at 298.15 K, *Fluid Phase Equilibria* 32 (1987) 249–260, doi:10.1016/0378-3812(87)85057-4.
- [1805] G. Schneider, *Z Phys Chem Muenchen Ger* 27 (1961) 171–184.
- [1806] M. Diaz Peña, A. Crespo-Colin, A. Compostizo, Gibb's excess free energy of methylcyclohexane + benzene and methylcyclohexane + toluene mixtures at 348.15 K, *J. Chem. Eng. Data.* 28 (1983) 30–33, doi:10.1021/je00031a009.
- [1807] D. Quiggle, M.R. Fenske, Vapor-Liquid Equilibria of Methylcyclohexane-Toluene Mixtures, *J. Am. Chem. Soc.* 59 (1937) 1829–1832, doi:10.1021/ja01289a012.
- [1808] S.R.M. Ellis, R.M. Contractor, Vapor-liquid equilibria at reduced pressure, *Chem Eng Lond* 15 (1964) 10–13.
- [1809] B. Tyminski, A. Klepanska, *Inz Chem* 7 (1977) 193–205.
- [1810] S.R.M. Ellis, F.R. Broughton, L.J.S. Soares, Recommended test mixtures for distillation columns, London (1969).
- [1811] M. Diaz Peña, A. Compostizo, A. Crespo Colin, Excess Gibbs free energies of mixtures of methylcyclohexane + o-xylene, + m-xylene, and + p-xylene at 348.15 K, *J. Chem. Thermodyn.* 11 (1979) 447–452, doi:10.1016/0021-9614(79)90122-8.
- [1812] M. del C. Sánchez-Russinyol, A. Aucejo, S. Loras, Isobaric Vapor-Liquid Equilibria for Binary and Ternary Mixtures of Ethanol, Methylcyclohexane, and p-Xylene, *J. Chem. Eng. Data.* 49 (2004) 1258–1262, doi:10.1021/je0342318.
- [1813] W. Wóycicki, Enthalpies of mixing of some binary mixtures of benzene, cy-

- clohexane, and pyridine, and their methyl and ethyl derivatives, *J. Chem. Thermodyn.* 4 (1972) 1–8, doi:10.1016/S0021-9614(72)80002-8.
- [1814] W.L. Spiteri, T.M. Letcher, The excess enthalpies of cycloheptane + an n-alkane, *J. Chem. Thermodyn.* 14 (1982) 1047–1050, doi:10.1016/0021-9614(82)90148-3.
- [1815] S. Porcedda, Excess enthalpy of cycloheptane with heptane, *Int DATA Ser Sel Data Mix. Ser A.* (1992) 92–101.
- [1816] K. Ohnishi, I. Fujihara, S. Murakami, Thermodynamic properties of decalins mixed with hexane isomers at 298.15 K. I. Excess enthalpies and excess isobaric heat capacities, *Fluid Phase Equilibria* 46 (1989) 59–72, doi:10.1016/0378-3812(89)80275-4.
- [1817] T.M. Letcher, B.W.H. Scoones, The excess enthalpies of bicyclohexyl + a cycloalkane and + an n-alkane at two temperatures, *J. Chem. Thermodyn.* 14 (1982) 703–706, doi:10.1016/0021-9614(82)90166-5.
- [1818] R.S. Jessup, C.L. Stanley, Heats and Volumes of Mixing in Several C12 Hydrocarbon Systems, *J. Chem. Eng. DATA.* 6 (1961) 4.
- [1819] T. Smola, H.-J. Bittrich, Excess Molar Enthalpies of N-Methyl- $\epsilon$ -Caprolactam (NMC) + Hydrocarbon Systems at 298.15 K, *Z. Für Phys. Chem.* 2700 (1989) 645–657, doi:10.1515/zpch-1989-27078.
- [1820] H. S. F. K. G. J., Experimental determination of critical points of pure substances and binary mixtures in a flow apparatus, *Chem. Ing. Tech.* 71 (1999) 725–728.
- [1821] J.C. Acosta, E. Hevia, S. Leipziger, Dew and bubble point measurements for carbon dioxide–propane mixtures, *J. Chem. Eng. Data.* 29 (1984) 304–309, doi:10.1021/je00037a024.
- [1822] M. Yorizane, S. Yoshimura, H. Masuoka, Measurements and Predictions of Multicomponent Vapor-Liquid Equilibria, *Bull. Jpn. Pet. Inst.* 14 (1972) 105–113, doi:10.1627/jpi1959.14.105.
- [1823] B. Yucelen, A.J. Kidnay, Vapor-Liquid Equilibria in the Nitrogen + Carbon Dioxide + Propane System from 240 to 330 K at Pressures to 15 MPa, *J. Chem. Eng. Data.* 44 (1999) 926–931, doi:10.1021/je980321e.
- [1824] L.A. Webster, A.J. Kidnay, Vapor-Liquid Equilibria for the Methane-Propane-Carbon Dioxide Systems at 230 K and 270 K, *J. Chem. Eng. Data.* 46 (2001) 759–764, doi:10.1021/je000307d.
- [1825] J.G. Roof, J.D. Baron, Critical loci of binary mixtures of propane with methane, carbon dioxide, and nitrogen, *J. Chem. Eng. Data.* 12 (1967) 292–293, doi:10.1021/je60034a003.
- [1826] G.-I. Kaminishi, C. Yokoyama, T. Shinji, Vapor pressures of binary mixtures of carbon dioxide with benzene, n-hexane and cyclohexane up to 7 MPa, *Fluid Phase Equilibria* 34 (1987) 83–99, doi:10.1016/0378-3812(87)85052-5.
- [1827] J.H. Kim, M.S. Kim, Vapor-liquid equilibria for the carbon dioxide + propane system over a temperature range from 253.15 to 323.15 K, *Fluid Phase Equilibria* 238 (2005) 13–19, doi:10.1016/j.fluid.2005.09.006.
- [1828] K. Nagahama, H. Konishi, D. Hoshino, M. Hirata, Binary vapor-liquid equilibria of carbon dioxide–light hydrocarbons at low temperature, *J. Chem. Eng. Jpn.* 7 (1974) 323–328, doi:10.1252/cej.7.323.
- [1829] H.H. Reamer, B.H. Sage, W.N. Lacey, Phase Equilibria in Hydrocarbon Systems. Volumetric and Phase Behavior of the Propane-Carbon Dioxide System, *Ind. Eng. Chem.* 43 (1951) 2515–2520, doi:10.1021/je50503a035.
- [1830] S.E.M. Hamam, B.C.Y. Lu, Isothermal vapor-liquid equilibria in binary system propane-carbon dioxide, *J. Chem. Eng. Data.* 21 (1976) 200–204, doi:10.1021/je60069a020.
- [1831] V.G. Niesen, J.C. Rainwater, Critical locus, (vapor + liquid) equilibria, and coexisting densities of (carbon dioxide + propane) at temperatures from 311 K to 361 K, *J. Chem. Thermodyn.* 22 (1990) 777–795, doi:10.1016/0021-9614(90)90070-7.
- [1832] F.H. Poettmann, D.L. Katz, Phase Behavior of Binary Carbon Dioxide-Paraffin Systems, *Ind. Eng. Chem.* 37 (1945) 847–853, doi:10.1021/je50429a017.
- [1833] G. Morrison, J.M. Kincaid, Critical point measurements on nearly polydisperse fluids, *AIChE J* 30 (1984) 257–262, doi:10.1002/aic.690300213.
- [1834] R.H. Olds, H.H. Reamer, B.H. Sage, W.N. Lacey, The n-Butane-Carbon Dioxide System, *Ind. Eng. Chem.* 41 (1949) 475–482, doi:10.1021/je50471a011.
- [1835] H. Kalra, T.R. Krishnana, D.B. Robinson, Equilibrium-phase properties of carbon dioxide-butane and nitrogen-hydrogen sulfide systems at subambient temperatures, *J. Chem. Eng. Data.* 21 (1976) 222–225, doi:10.1021/je60069a027.
- [1836] L.A. Weber, Vapor-liquid equilibria measurements for carbon dioxide with normal and isobutane from 250 to 280 K, *Cryogenics* 25 (1985) 338–342, doi:10.1016/0011-2275(85)90019-0.
- [1837] P.K. Behrens, S.J. Sandler, Vapor-liquid equilibria for the carbon dioxide-1-butene system at 37.7 and 45.0 degree.C, *J. Chem. Eng. Data.* 28 (1983) 52–56, doi:10.1021/je00031a015.
- [1838] S.K. Shibata, S.I. Sandler, High-pressure vapor-liquid equilibria involving mixtures of nitrogen, carbon dioxide, and n-butane, *J. Chem. Eng. Data.* 34 (1989) 291–298, doi:10.1021/je00057a011.
- [1839] T.S. Brown, V.G. Niesen, E.D. Sloan, A.J. Kidnay, Vapor-liquid equilibria for the binary systems of nitrogen, carbon dioxide, and n-butane at temperatures from 220 to 344 K, *Fluid Phase Equilibria* 53 (1989) 7–14, doi:10.1016/0378-3812(89)80067-6.
- [1840] V.G. Niesen, Vapor + liquid) equilibria and coexisting densities of (carbon dioxide + n-butane) at 311 to 395 K, *J. Chem. Thermodyn.* 21 (1989) 915–923, doi:10.1016/0021-9614(89)90150-X.
- [1841] M.E. Pozo de Fernandez, J.A. Zollweg, W.B. Streett, Vapor-liquid equilibrium in the binary system carbon dioxide + n-butane, *J. Chem. Eng. Data.* 34 (1989) 324–328, doi:10.1021/je00057a019.
- [1842] L.A. Weber, Simple apparatus for vapor-liquid equilibrium measurements with data for the binary systems of carbon dioxide with n-butane and isobutane, *J. Chem. Eng. Data.* 34 (1989) 171–175, doi:10.1021/je00056a007.
- [1843] A.D. Leu, D.B. Robinson, Equilibrium phase properties of the n-butane-carbon dioxide and isobutane-carbon dioxide binary systems, *J. Chem. Eng. Data.* 32 (1987) 444–447, doi:10.1021/je00050a017.
- [1844] J.J.C. Hsu, N. Nagarajan, R.L. Robinson, Equilibrium phase compositions, phase densities, and interfacial tensions for carbon dioxide + hydrocarbon systems. I. Carbon dioxide + n-butane, *J. Chem. Eng. Data.* 30 (1985) 485–491, doi:10.1021/je00042a036.
- [1845] P. Traub, K. Stephan, High-pressure phase equilibria of the system CO<sub>2</sub>–water–acetone measured with a new apparatus, *Chem. Eng. Sci.* 45 (1990) 751–758, doi:10.1016/0009-2509(90)87016-L.
- [1846] G.J. Besserer, D.B. Robinson, A high pressure autocollimating refractometer for determining coexisting liquid and vapor phase densities, *Can. J. Chem. Eng.* 49 (1971) 651–656, doi:10.1002/cjce.5450490517.
- [1847] R. Wang, Ph.D. Dissertation, University of Texas, 1963.
- [1848] K. Fischer, Diplomarbeit, Universität at Oldenburg, 1990.
- [1849] G.S. Gurdial, N.R. Foster, S.L.J. Yun, K.D. Tilly, Phase Behavior of Supercritical Fluid–Entrainer Systems, *Supercrit. Fluid Eng. Sci.* (1992) 34–45, doi:10.1021/bk-1992-0514.ch003.
- [1850] K. Nagahama, K. Kato, High pressure vapor–liquid equilibria for systems containing carbon dioxide, pentane and heptane at 343 K, *Sekiyu Gakkaishi* 27 (1984) 506–511.
- [1851] G.J. Besserer, D.B. Robinson, Equilibrium-phase properties of n-pentane-carbon dioxide system, *J. Chem. Eng. Data.* 18 (1973) 416–419, doi:10.1021/je60059a020.
- [1852] H. Cheng, M.E. Pozo de Fernandez, J.A. Zollweg, W.B. Streett, Vapor-liquid equilibrium in the system carbon dioxide + n-pentane from 252 to 458 K at pressures to 10 MPa, *J. Chem. Eng. Data.* 34 (1989) 319–323, doi:10.1021/je00057a018.
- [1853] A.D. Leu, D.B. Robinson, Equilibrium phase properties of selected carbon dioxide binary systems: n-pentane-carbon dioxide and isopentane-carbon dioxide, *J. Chem. Eng. Data.* 32 (1987) 447–450, doi:10.1021/je00050a018.
- [1854] E. Levitskaya, K. Pryannikov, Equilibrium between liquid and vapor in the system of hydrogen and ethane, *ZhTekh Fiz* 9 (1939) 1849–1853.
- [1855] N. Xu, J. Yao, Y. Wang, J. Shi, B.C.-Y. Lu, Vapor-liquid equilibria of five binary systems containing R-22, *Fluid Phase Equilibria* 69 (1991) 261–270, doi:10.1016/0378-3812(91)90038-9.
- [1856] K. Tochigi, K. Hasegawa, N. Asano, K. Kojima, Vapor-Liquid Equilibria for the Carbon Dioxide + Pentane and Carbon Dioxide + Toluene Systems, *J. Chem. Eng. Data.* 43 (1998) 954–956, doi:10.1021/je980052s.
- [1857] T. Sako, I. Hayano, T. Sugeta, High pressure vapor–liquid equilibria for binary systems of carbon dioxide–pentane, –isoprene, –1-pentene and –2-pentene, *Sekiyu Gakkaishi* 29 (1986) 228–233.
- [1858] J. Chen, W. Wu, B. Han, L. Gao, T. Mu, Z. Liu, T. Jiang, J. Du, Phase Behavior, Densities, and Isothermal Compressibility of CO<sub>2</sub> + Pentane and CO<sub>2</sub> + Acetone Systems in Various Phase Regions, *J. Chem. Eng. Data.* 48 (2003) 1544–1548, doi:10.1021/je034087q.
- [1859] C. Pando, J.A.R. Renuncio, R.M. Izatt, J.J. Christensen, The excess enthalpies of (carbon dioxide + pentane) at 308.15 and 323.15 K from 7.58 to 12.45 MPa, *J. Chem. Thermodyn.* 15 (1983) 259–266, doi:10.1016/0021-9614(83)90118-0.
- [1860] J.J. Christensen, P.W. Faux, D. Cordray, R.M. Izatt, The excess enthalpies of (carbon dioxide + pentane) at 348.15, 373.15, 413.15, 470.15, and 573.15 K from 7.58 to 12.45 MPa, *J. Chem. Thermodyn.* 18 (1986) 1053–1064, doi:10.1016/0021-9614(86)90020-0.
- [1861] B. Wang, J. He, D. Sun, R. Zhang, B. Han, Solubility of chlorobutane, ethyl methacrylate and trifluoroethyl acrylate in supercritical carbon dioxide, *Fluid Phase Equilibria* 239 (2006) 63–68, doi:10.1016/j.fluid.2005.10.023.
- [1862] Y.-H. Li, K.H. Dillard, R.L. Robinson, Vapor-liquid phase equilibrium for carbon dioxide–n-hexane at 40, 80, and 120 degree.C, *J. Chem. Eng. Data.* 26 (1981) 53–55, doi:10.1021/je00023a018.
- [1863] Z. Wagner, I. Wichterle, High-pressure vapour–liquid equilibrium in systems containing carbon dioxide, 1-hexene, and n-hexane, *Fluid Phase Equilibria* 33 (1987) 109–123, doi:10.1016/0378-3812(87)87006-1.
- [1864] E. Shenderei, F. Ivanovskii, Solubility of carbon dioxide in hexane, nheptane, and n-octane under pressure at a low temperature, *Khim Prom* (1964) 506–508.
- [1865] D. Chen, W. Chen, Phase equilibria of n-hexane and n-octane in critical carbon dioxide, *Huaxue Gongcheng* 20 (1992) 66–69.
- [1866] E.-J. Choi, S.-D. Yeo, Critical properties for carbon dioxide + n-alkane mixtures using a variable-volume view cell, *J. Chem. Eng. Data.* 43 (1998) 714–716, doi:10.1021/je9800297.
- [1867] E.N. Lay, V. Taghikhani, C. Ghotbi, Measurement and Correlation of CO<sub>2</sub> Solubility in the Systems of CO<sub>2</sub> + Toluene, CO<sub>2</sub> + Benzene, and CO<sub>2</sub> + n-Hexane at Near-Critical and Supercritical Conditions, *J. Chem. Eng. Data.* 51 (2006) 2197–2200, doi:10.1021/je0602972.
- [1868] J.J. Christensen, T.A.C. Walker, R.S. Schofield, P.W. Faux, P.R. Harding, R.M. Izatt, The excess enthalpies of (carbon dioxide + hexane) at 308.15, 358.15, and 413.15 K from 7.50 to 12.50 MPa, *J. Chem. Thermodyn.* 16 (1984) 445–451, doi:10.1016/0021-9614(84)90201-5.
- [1869] J.J. Christensen, D.M. Zebolsky, R.M. Izatt, The excess enthalpies of (carbon dioxide + hexane) at 470.15, 510.15, and 573.15 K from 7.50 to 12.50 MPa, *J. Chem. Thermodyn.* 17 (1985) 183–192, doi:10.1016/0021-9614(85)90070-9.
- [1870] W.K. Tolley, R.M. Izatt, J.L. Oscarson, Simultaneous measurement of excess enthalpies and solution densities in a flow calorimeter, *Thermochim. Acta.* 181 (1991) 127–141, doi:10.1016/0040-6031(91)80418-1.

- [1871] F. Mutelet, S. Vitu, R. Privat, J.-N. Jaubert, Solubility of CO<sub>2</sub> in branched alkanes in order to extend the PPR78 model (predictive 1978, Peng-Robinson EOS with temperature-dependent kij calculated through a group contribution method) to such systems, *Fluid Phase Equilibria* 238 (2005) 157–168, doi:10.1016/j.fluid.2005.10.001.
- [1872] H. Kalra, H. Kubota, D.B. Robinson, H.-J. Ng, Equilibrium phase properties of the carbon dioxide–n-heptane system, *J. Chem. Eng. Data* 23 (1978) 317–321, doi:10.1021/je60079a016.
- [1873] A. Fenghour, J.P.M. Trusler, W.A. Wakeham, Densities and bubble points of binary mixtures of carbon dioxide and n-heptane and ternary mixtures of n-butane, n-heptane and n-hexadecane, *Fluid Phase Equilibria* 185 (2001) 349–358, doi:10.1016/S0378-3812(01)00483-6.
- [1874] Y. He, Z. Luo, S. Ma, Y. Hu, Measuring phase equilibria of carbon dioxide–n-heptane system by stoichiometry, *Huadong Ligong Daxue Xuebao* 20 (1994) 79–84.
- [1875] R. Jiménez-Gallegos, L.A. Galicia-Luna, O. Elizalde-Solis, Experimental Vapor-Liquid Equilibria for the Carbon Dioxide+Octane and Carbon Dioxide+Decane Systems, *J. Chem. Eng. Data* 51 (2006) 1624–1628, doi:10.1021/je060111z.
- [1876] J. Yu, S. Wang, Y. Tian, Experimental determination and calculation of thermodynamic properties of CO<sub>2</sub>+octane to high temperatures and high pressures, *Fluid Phase Equilibria* 246 (2006) 6–14, doi:10.1016/j.fluid.2006.05.014.
- [1877] M.A. Barrufet, J.F.S. Wirawan, G.A. Iglesias-Silva, An efficient procedure to measure bubble point pressures for hydrocarbon+CO<sub>2</sub> mixtures, *J. Chem. Eng. Data* 40 (1995) 1072–1075, doi:10.1021/je00021a009.
- [1878] Z. Yun, M. Shi, J. Shi, High pressure vapor-liquid phase equilibria for carbon dioxide–n-octane and carbon dioxide–n-nonane, *Gaoxiao Huaxue Gongcheng Xuebao* 9 (1995) 396–399.
- [1879] W. Stewart, R. Nielsen, Phase equilibria for mixtures of carbon dioxide and several normal saturated hydrocarbons, *Bull. Earth Min. Sci. Exp. Stn.* 62 (1953) 19–29.
- [1880] H. Buxing, Y. Haike, H. Riheng, Solubility of CO<sub>2</sub> in a mixed solvent of n-octane and i-octane at elevated pressures, *Thermochim. Acta* 169 (1990) 217–221, doi:10.1016/0040-6031(90)80148-R.
- [1881] M. Paulaitis, J. Penninger, R. Gray, P. Davidson, *Chemical engineering at supercritical fluid conditions*, *Ann. Arbor Sci.* (1983).
- [1882] G. Schneider, Z. Alwani, W. Heim, E. Horvath, E.U. Franck, Phasengleichgewichte und kritische Erscheinungen in binären Mischsystemen bis 1500 bar, CO<sub>2</sub> mit n-Octan, n-Undecan, n-Tridecan und n-Hexadecan, *Chem. Ing. Tech.* 39 (1967) 649–656, doi:10.1002/cite.330391103.
- [1883] D.R. Cordray, L.D. Gunderson, J.L. Oscarson, R.M. Izatt, The excess molar enthalpies of [xCO<sub>2</sub> + (1-x)(0.5CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>CH<sub>3</sub> + 0.5CH<sub>3</sub>(CH<sub>2</sub>)<sub>10</sub>CH<sub>3</sub>)] at the temperatures (308.15, 323.15, 373.15, and 413.15) K and at the pressures 7.50 MPa and 12.50 MPa, and of [xCO<sub>2</sub> + (1-x)CH<sub>3</sub>(CH<sub>2</sub>)<sub>7</sub>CH<sub>3</sub>] at 373.15 K and 7.50 MPa and 12.50 MPa, *J. Chem. Thermodyn.* 23 (1991) 941–949, doi:10.1016/S0021-9614(05)80175-2.
- [1884] N. Nagarajan, R.L. Robinson, Equilibrium phase compositions, phase densities, and interfacial tensions for carbon dioxide + hydrocarbon systems. 2. Carbon dioxide + n-decane, *J. Chem. Eng. Data* 31 (1986) 168–171, doi:10.1021/je00044a012.
- [1885] H.M. Sebastian, J.J. Simnick, H.-M. Lin, K.-C. Chao, Vapor-liquid equilibrium in binary mixtures of carbon dioxide + n-decane and carbon dioxide + n-hexadecane, *J. Chem. Eng. Data* 25 (1980) 138–140, doi:10.1021/je60085a012.
- [1886] B. Han, D.-Y. Peng, C.-T. Fu, G. Vilcsak, An apparatus for phase equilibrium studies of carbon dioxide+heavy hydrocarbon systems, *Can. J. Chem. Eng.* 70 (1992) 1164–1171, doi:10.1002/cjce.5450700617.
- [1887] G.F. Chou, R.R. Forbert, J.M. Prausnitz, High-pressure vapor-liquid equilibria for carbon dioxide/n-decane, carbon dioxide/tetralin, and carbon dioxide/n-decane/tetralin at 71.1 and 104.4 degree. C, *J. Chem. Eng. Data* 35 (1990) 26–29, doi:10.1021/je00059a008.
- [1888] W.R. Adams, J.A. Zollweg, W.B. Streett, S.S.H. Rizvi, New apparatus for measurement of supercritical fluid-liquid phase equilibria, *AIChE J* 34 (1988) 1387–1391, doi:10.1002/aic.690340820.
- [1889] S.J. Chen, R.E. Rindelman, R.L. Seldomridge, M. Radosz, Mass spectrometer composition probe for batch cell studies of supercritical fluid phase equilibria, *J. Chem. Eng. Data* 38 (1993) 211–216, doi:10.1021/je00010a006.
- [1890] K. Chyliński, J. Gregorowicz, Solubilities of 1-propanol and 1,2-propanediol in supercritical carbon dioxide. New analytical procedure and measurements, *Fluid Phase Equilibria* 143 (1998) 163–172, doi:10.1016/S0378-3812(97)00290-2.
- [1891] R. Eustaquio-Rincón, A. Trejo, Solubility of n-octadecane in supercritical carbon dioxide at 310, 313, 333, and 353 K, in the range 10–20 MPa, *Fluid Phase Equilibria* 185 (2001) 231–239, doi:10.1016/S0378-3812(01)00473-3.
- [1892] Y. Iwai, N. Hosotani, T. Morotomi, Y. Koga, Y. Arai, High-Pressure Vapor-Liquid Equilibria for Carbon Dioxide + Linalool, *J. Chem. Eng. Data* 39 (1994) 900–902, doi:10.1021/je00016a059.
- [1893] A.A. Kulkarni, K.D. Luks, J.P. Kohn, Phase-equilibria behavior of systems carbon dioxide–2-methylnaphthalene and carbon dioxide–n-decane–2-methylnaphthalene, *J. Chem. Eng. Data* 19 (1974) 349–354, doi:10.1021/je60063a025.
- [1894] T. Tsuji, S. Tanaka, T. Hiaki, R. Saito, Measurements of bubble point pressure for CO<sub>2</sub> + decane and CO<sub>2</sub> + lubricating oil, *Fluid Phase Equilibria* 219 (2004) 87–92, doi:10.1016/j.fluid.2004.01.019.
- [1895] R.D. Shaver, R.L. Robinson, K.A.M. Gasem, An automated apparatus for equilibrium phase compositions, densities, and interfacial tensions: data for carbon dioxide + decane, *Fluid Phase Equilibria* 179 (2001) 43–66, doi:10.1016/S0378-3812(00)00475-1.
- [1896] J.J. Christensen, D. Cordray, R.M. Izatt, The excess enthalpies of (carbon dioxide + decane) from 293.15 to 573.15 K at 12.50 MPa, *J. Chem. Thermodyn.* 18 (1986) 53–61, doi:10.1016/0021-9614(86)90043-1.
- [1897] C. Pando, J.A.R. Renuncio, T.A. McFall, R.M. Izatt, J.J. Christensen, The excess enthalpies of (carbon dioxide + decane) from 283.15 to 323.15 K at 7.58 MPa, *J. Chem. Thermodyn.* 15 (1983) 173–180, doi:10.1016/0021-9614(83)90157-X.
- [1898] L.E. Camacho-Camacho, L.A. Galicia-Luna, O. Elizalde-Solis, Z. Martínez-Ramírez, New isothermal vapor-liquid equilibria for the CO<sub>2</sub>+n-nonane, and CO<sub>2</sub>+n-undecane systems, *Fluid Phase Equilibria* 259 (2007) 45–50, doi:10.1016/j.fluid.2007.04.022.
- [1899] J.D. Hottovy, K.D. Luks, J.P. Kohn, Three-phase liquid-liquid-vapor equilibria behavior of certain binary carbon dioxide–n-paraffin systems, *J. Chem. Eng. Data* 26 (1981) 256–258, doi:10.1021/je00025a009.
- [1900] A.B. De Haan, *Supercritical fluid extraction of liquid hydrocarbon mixtures*, The Delft University of Technology, 1991.
- [1901] E. Picqueard, H. Kehiaian, L. Abello, G. Pannetier, Enthalpies of mixing of aromatic hydrocarbon–n-alkane systems, *Bull. Soc. Chim. Fr.* 1 (1972) 120–124.
- [1902] M.D. Peña, A. Compostizo, A. Crespo Colín, Excess Gibbs free energy of (n-heptane + a xylene) at 348.15 K, *J. Chem. Thermodyn.* 12 (1980) 259–263, doi:10.1016/0021-9614(80)90045-2.
- [1903] P.C. Proust, A.L. Ramirez, J.B. Yianatos, Vapor-liquid equilibria for the system n-heptane–o-xylene at 348.1, 358.1, and 368.3 K, *J. Chem. Eng. Data* 25 (1980) 329–331, doi:10.1021/je60087a015.
- [1904] C. Díaz, J. Tojo, Phase equilibria behaviour of n-heptane with o-xylene, m-xylene, p-xylene and ethylbenzene at 101.3kPa, *J. Chem. Thermodyn.* 34 (2002) 1975–1984, doi:10.1016/S0021-9614(02)00227-6.
- [1905] I. Kukharenek, E. Stepanova, M. Kharisov, Study of Vapor-Liquid Equilibrium for o-Xylene + n-Nonane System, *Zh Prikl. Khim.* 59 (1986) 716–717.
- [1906] H. Kirss, E. Siimer, M. Kuus, L. Kudryavtseva, Isobaric Vapor-Liquid Equilibria in the System o-Xylene + Amyl Acetate + Nonane, *J. Chem. Eng. Data* 46 (2001) 147–150, doi:10.1021/je000058t.
- [1907] E. Siimer, H. Kirss, M. Kuus, L. Kudryavtseva, Excess enthalpies for the systems o-xylene + cyclohexanol + nonane at 298.15 K and 318.15 K and 3-methylphenol + 1-hexanol + heptane at 298.15 K and for constituent binaries, *J. Chem. Eng. Data* 42 (1997) 619–622, doi:10.1021/je960396n.
- [1908] D.V.S. Jain, N.S. Dhar, Excess enthalpies of binary mixtures nonane + ethylbenzene, + o-xylene, + m-xylene, + p-xylene at 298.15 K, *Indian J. Technol.* 25 (1987) 591–593.
- [1909] W. Gerrard, Significance of the solubility of hydrocarbon gases in liquids in relation to the intermolecular structure of liquids and the essential pattern of data for all gases, *J. Appl. Chem. Biotechnol.* 23 (1973) 1–17, doi:10.1002/jctb.5020230102.
- [1910] R.A. Mentzer, R.A. Greenkorn, K.C. Chao, Bubble pressures and vapor-liquid equilibria for four binary hydrocarbon mixtures, *J. Chem. Thermodyn.* 14 (1982) 817–830, doi:10.1016/0021-9614(82)90155-0.
- [1911] T.E.V. Prasad, A.N. Raju, N. Sriram, D.H.L. Prasad, Bubble temperature measurements on the binary mixtures formed by decane with a variety of compounds at 95.8kPa, *Fluid Phase Equilibria* 227 (2005) 37–39, doi:10.1016/j.fluid.2004.10.027.
- [1912] B. Wiśniewska, Vapour pressures and excess Gibbs energies of {ethylbenzene + (methyl- or n-propyl- or isopropyl- or n-butyl- or 1,2-dimethyl- or 1,4-dimethyl- or 1,2,4-trimethyl-benzene or methylcyclohexane or heptane or octane)} at 373.15 K, *J. Chem. Thermodyn.* 19 (1987) 897–901, doi:10.1016/0021-9614(87)90035-8.
- [1913] H.V. Kehiaian, K. Sosnkowska-Kehiaian, R. Hryniewicz, Enthalpy of mixing of ethers with hydrocarbons at 25 °C and its analysis in terms of molecular surface interactions, *J. Chim. Phys.* 68 (1971) 922–934, doi:10.1051/jcp/1971680922.
- [1914] H.-I. Paul, J. Krug, H. Knapp, Measurements of VLE, hE and vE for binary mixtures of n-alkanes with n-alkylbenzenes, *Thermochim. Acta* 108 (1986) 9–27, doi:10.1016/0040-6031(86)85073-0.
- [1915] A. Cannas, B. Marongiu, S. Porcedda, Thermodynamic properties of n-alkylbenzene+n-alkane or cyclohexane mixtures. Comparison with disquac predictions. This paper is a contribution to the TOM Project 6, 7, 8, 1, *Thermochim. Acta* 311 (1998) 1–19, doi:10.1016/S0040-6031(97)00364-X.
- [1916] C.P. Yang, M.V. Winkle, Vapor-Liquid Equilibria at Subatmospheric Pressures - n - Octane - Ethylbenzene System, *Ind. Eng. Chem.* 47 (1955) 293–296, doi:10.1021/ie50542a035.
- [1917] H.H. Hamza, P.G. Mikolaj, Vapor-liquid equilibrium for n-octane + ethylbenzene at 200 Torr, *J. Chem. Thermodyn.* 7 (1975) 777–779, doi:10.1016/0021-9614(75)90253-0.
- [1918] P.S. Murti, M.V. Winkle, Vapor-liquid equilibria and heat of mixing: n-octane–ethylbenzene–cellosolve system, *AIChE J* 3 (1957) 517–522, doi:10.1002/aic.690030417.
- [1919] R.L. Arenosa, R.G. Rubio, C. Menduina, M. Diaz Peña, Excess enthalpies of binary mixtures of ethylbenzene + n-alkanes, *J. Chem. Eng. Data* 30 (1985) 24–26, doi:10.1021/je00039a008.
- [1920] H.I. Paul, Experimental Investigation of the Vapor-Liquid Equilibria and the Volumetric Properties of binary and ternary Mixtures, *VDI Forschungsh Reihe 3 Verfahrenst* (1987) 135.
- [1921] S. Laugier, A. Valtz, A. Charetton, *Gas Process, Assoc. Res. Rep.* RR-88, (1985).
- [1922] S. Haynes, M.V. Winkle, Vapor-Liquid Equilibrium of Naphthalene–n-

- Tetradecene System at Subatmospheric Pressures, *Ind. Eng. Chem.* 46 (1954) 334–338, doi:10.1021/je50530a036.
- [1923] G. Arich, G. Tagliavini, Isotherme di equilibrio liquido-vapore nel sistema acqua-acido acetico, *Ric. Sci.* 28 (1958) 2493–2500.
- [1924] J. Griswold, D. Andres, V. Klein, Determination of high-pressure vapor-liquid equilibria. The vapor-liquid equilibrium of benzene-toluene, *Trans Am Inst Chem Eng* 39 (1943) 223–240.
- [1925] M.A. Rosanoff, C.W. Bacon, J.F.W. Schulze, A method of finding the partial from the total vapor pressures of binary mixtures, and a theory of fractional distillation, *J. Am. Chem. Soc.* 36 (1914) 1993–2004, doi:10.1021/ja02187a002.
- [1926] G.C. Schmidt, Binäre Gemische, *Z. Für Phys. Chem.* 121U (1926) 221–253, doi:10.1515/zpch-1926-12119.
- [1927] W.D. Kesselman, G.E. Hollenbach, A.L. Myers, A.E. Humphrey, Vapor-liquid equilibrium data for benzene-alkyl-benzene systems, *J. Chem. Eng. Data.* 13 (1968) 34–36, doi:10.1021/je60036a011.
- [1928] A. Rollet, E. Elkaim, P. Toledano, M. Senez, Les equilibres liquide-vapeur du système binaire benzenetoluene, *Compt. Rend.* 242 (1956) 2560–2563.
- [1929] P. Heertjes, *Chem Proc Eng* 41 (1960) 385–386.
- [1930] B. Meeboer, Vapor-liquid equilibria data collection, DECHEMA (1980).
- [1931] A.M. Clark, A new general equation for the liquid-vapour relations of binary systems. part I. theoretical and experimental basis, *Trans. Faraday Soc.* 41 (1945) 718–737, doi:10.1039/TF9454100718.
- [1932] H. Schuberth, Phasengleichgewichtsmessungen. II. Vorausberechnung von Gleichgewichtsdaten dampfförmig-flüssig idealer binärer Systeme und Prüfung derselben mittels einer neuen Gleichgewichtsapparatur, *J. Für Prakt. Chem.* 6 (1958) 129–138, doi:10.1002/prac.19580060209.
- [1933] S.M. Klara, R.S. Mohamed, D.M. Dempsey, G.D. Holder, Vapor-liquid equilibria for the binary systems of benzene-toluene, diphenylmethane-toluene, m-cresol-1,2,3,4-tetrahydronaphthalene, and quinoline-benzene, *J. Chem. Eng. Data.* 32 (1987) 143–147, doi:10.1021/je00048a004.
- [1934] N. Gultekin, Vapor-liquid equilibria at 1 atm for binary and ternary systems composed of benzene, toluene, and m-xylene, *J. Chem. Eng. Data.* 35 (1990) 130–132, doi:10.1021/je00060a009.
- [1935] K.-D. Kassmann, H. Knapp, Vapor-Liquid Equilibria for Binary and Ternary Mixtures of Benzene, Toluene and n-Butyraldehyde, *Berichte Bunsenges. Für Phys. Chem.* 90 (1986) 452–458, doi:10.1002/bbpc.19860900514.
- [1936] K. Joshi, Ph.D. Dissertation (1979).
- [1937] Z. Jin, A. Hu, K. Liu, VLE of Binary and Ternary Systems for BTX Mixtures, *Chem. Eng. China.* 19 (1991) 56–60.
- [1938] M. Diaz Peña, C. Menduina, Semicontinuous calorimeter for measuring heats of mixing, *Quim* 69 (1973) 857–868.
- [1939] G.H. Cheesman, W.R. Ladner, E.A. Guggenheim, The variation of the heat of mixing with temperature, *Proc. R. Soc. Lond. Ser. Math. Phys. Sci.* 229 (1955) 387–395, doi:10.1098/rspa.1955.0094.
- [1940] S. Murakami, V.T. Lam, G.C. Benson, The thermodynamic properties of binary aromatic systems II. Excess enthalpies and volumes of benzene+toluene and toluene+isomeric xylene mixtures at 25 °C, *J. Chem. Thermodyn.* 1 (1969) 397–407, doi:10.1016/0021-9614(69)90070-6.
- [1941] K.Y. Hsu, H.L. Clever, The excess enthalpies of the 15 binary mixtures formed from cyclohexane, benzene, toluene, 1,4-dimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene at 298.15 K, *J. Chem. Thermodyn.* 7 (1975) 435–442, doi:10.1016/0021-9614(75)90273-6.
- [1942] R.P. Rastogi, J. Nath, J. Misra, Thermodynamics of weak interactions in liquid mixtures. I. Mixtures of carbon tetrachloride, benzene, toluene, and p-xylene, *J. Phys. Chem.* 71 (1967) 1277–1286, doi:10.1021/j100864a015.
- [1943] J. Canning, G.H. Cheesman, Heat of mixing of liquids, *J. Chem. Soc.* (1955) 1230–1233.
- [1944] D. Diez, B. Ruiz, F.M. Royo, C.Gutierrez Losa, Excess molar enthalpies at 298.15 K of (cyclohexane+a methylpyridine) and of (benzene+a methylpyridine), *J. Chem. Thermodyn.* 17 (1985) 371–377, doi:10.1016/0021-9614(85)90134-X.
- [1945] R. Kremann, R. Meingast, F. Gugl, Über die Energieänderungen binärer Systeme, *Monatshefte Für Chem. Verwandte Teile Anderer Wiss.* 35 (1914) 1235–1322. <https://doi.org/10.1007/BF01517560>.
- [1946] J.L. Fortier, G.C. Benson, Heat capacities of some binary aromatic hydrocarbon mixtures containing benzene or toluene, *J. Chem. Eng. Data.* 24 (1979) 34–37, doi:10.1021/je60080a015.
- [1947] E. Kirschbaum, F. Gerstner, *Z. Ver. VDI Beih Verfahrenstechnik* 1 (1939) 10–15.
- [1948] R. Kutsarov, N. Ralev, V. Sharlopov, Study of liquid- vapor phase equilibrium for binary systems of aromatic hydrocarbons C 6- C 8, *Zh. Prikl. Khim.* 66 (1993) 567–573.
- [1949] R.P. Rastogi, J. Nath, J. Misra, Thermodynamics of weak interactions in liquid mixtures. II. Mixtures of carbon tetrachloride, benzene, o-xylene, and m-xylene, *J. Phys. Chem.* 71 (1967) 2524–2535, doi:10.1021/j100867a021.
- [1950] M.I. Paz Andrade, M.C. Baluja, L. Nunez, Microcalorimetry of heats of mixing benzene-o-xylene, benzene-m-xylene, and benzene-p-xylene systems at 25.deg, *Quim* 67 (1971) 17–22.
- [1951] M.I. Paz-Andrade, C. Hernandez, L. Nunez, E. Jimenez, Microcalorimetric study of heats of mixing. Benzene-o-, m-, and p-xylene systems at 50.deg, *J Chim Phys Physicochim Biol* 69 (1972) 1132–1135.
- [1952] J. Singh, H.D. Pflug, G.C. Benson, Molar excess enthalpies and volumes of benzene-isomeric xylene systems at 25.deg, *J. Phys. Chem.* 72 (1968) 1939–1944, doi:10.1021/j100852a014.
- [1953] T. Boublík, G.C. Benson, Molar excess Gibbs free energies of benzene - m-xylene mixtures, *Can. J. Chem.* 47 (1969) 539–542, doi:10.1139/v69-082.
- [1954] N. Gultekin, *Chim. Acta Turc.* 13 (1985) 369–389.
- [1955] J.B. Ott, K.N. Marsh, R.H. Stokes, Excess enthalpies, excess volumes, and excess Gibbs free energies for benzene+p-xylene at 288.15, 198.15, 308.15, and 318.15 K, *J. Chem. Thermodyn.* 12 (1980) 493–503, doi:10.1016/0021-9614(80)90064-6.
- [1956] C. Sharma, L. Lakhnpal, L. Rumpaul, Enthalpies of mixing of v-xylene with benzene, dioxane, cyclohexane & methylcyclohexane, *Indian Journal of Chemistry -Section A* 20 (1981) 225–227.
- [1957] J.B. Ott, J.R. Goates, R.B. Grigg, Excess volumes, enthalpies, and Gibbs free energies for mixtures of benzene + p-xylene, *J. Chem. Thermodyn.* 11 (1979) 1167–1173, doi:10.1016/0021-9614(79)90109-5.
- [1958] V.H. Khan, S.V. Subrahmanyam, Excess thermodynamic functions of the systems: benzene + p-xylene and benzene + p-dioxan, *Trans. Faraday Soc.* 67 (1971) 2282–2291, doi:10.1039/TF9716702282.
- [1959] A.M. Al-Ghamdi, V.N. Kabad, High Temperature VLE for the Benzene-Ethylbenzene System, *J. Chem. Eng. Data.* 46 (2001) 1330–1332, doi:10.1021/je000172b.
- [1960] W. Wóycicki, K. Sadowska, Heat and volume of mixing of pyridine or alpha-picolone with cyclohexane or methylcyclohexane, *Bull. Acad. Pol. Sci. Ser. Sci. Chim.* 16 (1968) 147–153.
- [1961] R. Tanaka, G.C. Benson, Excess enthalpies of some ethylbenzene + aromatic hydrocarbon mixtures at 298.15 K, *J. Chem. Thermodyn.* 8 (1976) 259–268, doi:10.1016/0021-9614(76)90104-X.
- [1962] A.E. Lutsikii, E.M. Obukhova, B.G. Petrenko, The heat of mixing and the dipole moments of the molecules of components, *Zh. Fiz. Khim.* 32 (1958) 720–721.
- [1963] J. Grolier, A. Faradjadeh, Excess Volumes and Excess Heat Capacities of Monoalkylbenzenes (C8 - C10) + Benzene Mixtures, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1983) 247–252.
- [1964] W. Wóycicki, K.W. Sadowska, Enthalpies and volumes of mixing in the systems: n-propylbenzene with benzene, toluene and ethylbenzene and n-butylbenzene with benzene, toluene, ethylbenzene and n-propylbenzene, *Bull. Acad. Pol. Sci. Ser. Sci. Chim.* 25 (1977) 115–121.
- [1965] D.V.S. Jain, N.S. Dhar, Excess enthalpies of binary mixtures of benzene with n-propylbenzene, n-butylbenzene, n-hexylbenzene AT 298.15, 308.15 and 318.15 K, *Fluid Phase Equilibria* 47 (1989) 89–94, doi:10.1016/0378-3812(89)80052-4.
- [1966] S.M. Ashraf, D.H.L. Prasad, Isothermal phase equilibrium studies on the binary mixtures of some alkylbenzenes, *Phys. Chem. Liq.* 37 (1999) 373–380, doi:10.1080/00319109908031442.
- [1967] Q. Zhang, S. Chen, *J. Fushun Pet. Inst.* 15 (1995) 8–11.
- [1968] A. Hu, K. Liu, Z. Jin, Vapor-liquid equilibrium data for toluene - p-xylene system, *Shiyou Huangong* 19 (1990) 306–308.
- [1969] J. Schmelzer, C. Wolf, Prediction of isobaric vapor-liquid equilibrium for system benzene-toluene-normal-octane-para-xylene, *Chem Tech Leipz* 30 (1978) 305–307.
- [1970] O. Sartakova, O. Krutko, M. Khristenko, L. Kormina, Investigation of technical schemes for the separation of toluene and diglyme mixtures, *Zh. Prikl. Khim.* 69 (1996) 1077–1080.
- [1971] H. Kirss, M. Kuus, Isobaric vapour-liquid equilibria of the ternary system toluene+ p-xylene+ 1, 2-dichloroethane, *Proc Est. Acad Sci Chem.* 51 (2002) 215–224.
- [1972] C. Kracht, P. Ulbig, S. Schulz, Molar excess enthalpies of binary mixtures containing chlorobenzene, o-dichlorobenzene, toluene, 4-chlorotoluene, and o-xylene, *Priv. Commun.* (1999) 1–21.
- [1973] H. Arm, F. Hügli, R. Signer, Thermodynamische Messungen an Gemischen von Äthylbenzol mit Toluol und Methyläthylketon, *Helv. Chim. Acta.* 40 (1957) 1200–1205, doi:10.1002/hlca.19570400511.
- [1974] R. Martirosyan, V. Beregovykh, Z. Pluzhnikova, G. Kolyuchkina, S. L'vov, L. Serafimov, Physical-Chemical Properties of Binary Systems Formed by Ethylbenzene Dehydrogenation Products, *Tr Mosk Inst Tonkoi Khim Tekhnol* 4 (1974) 122–125.
- [1975] R. Wohland, D. Pape, *FIZ Rep.* (1975) 5201.
- [1976] G. Lewis, A.F. Johnson, Heats of mixing of toluene and ethylbenzene, *J. Chem. Eng. Data.* 14 (1969) 484–486, doi:10.1021/je60043a035.
- [1977] W. Wóycicki, Enthalpies of mixing of some binary mixtures of benzene, cyclohexane, and pyridine, and their methyl and ethyl derivatives. Part 2, *J. Chem. Thermodyn.* 6 (1974) 141–147, doi:10.1016/0021-9614(74)90257-2.
- [1978] W.M. Recko, K.W. Sadowska, Heat of mixing and excess volumes of systems formed by halogen and alkyl derivatives of benzene, *Bull. Acad. Pol. Sci. Ser. Sci. Chim.* 17 (1969) 307–310.
- [1979] S. Malanowski, B. Swiatek, *Int. Data Ser. Sel. Data Mix. Ser. A.* 22 (1994) 321.
- [1980] F.J. Llopis, J.B. Monton, Isobaric vapor-liquid equilibria of p-xylene + o-xylene and m-xylene + o-xylene systems at 6.66 and 26.66 kPa, *J. Chem. Eng. Data.* 39 (1994) 53–55, doi:10.1021/je00013a015.
- [1981] D.L. Holt, B.D. Smith, Measurement of excess enthalpies with Tronac titration calorimeter. Data for some C8 aromatic binaries, *J. Chem. Eng. Data.* 19 (1974) 129–133, doi:10.1021/je60061a014.
- [1982] V.T. Lam, S. Murakami, G.C. Benson, The thermodynamic properties of binary aromatic systems III. Excess enthalpies and volumes of isomeric xylene mixtures at 25 °C, *J. Chem. Thermodyn.* 2 (1970) 17–25, doi:10.1016/0021-9614(70)90060-1.
- [1983] J.-L. Fortier, G.C. Benson, Heat capacities of binary C8 alkylbenzene mixtures, *J. Chem. Eng. Data.* 25 (1980) 47–49, doi:10.1021/je60084a027.
- [1984] D.V.S. Jain, R. Chadha, S.K. Sehgal, Excess molar heat capacities of binary

- mixtures of the isomeric xylenes at 303.65–321.65 K, Fluid Phase Equilibria 96 (1994) 195–202, doi:10.1016/0378-3812(94)80095-2.
- [1985] S. Malanowski, B. Swiatek, Unpubl. Data. (2022).
- [1986] J.B. Monton, F.J. Llopis, Isobaric vapor-liquid equilibria of ethylbenzene + m-xylene and ethylbenzene + o-xylene systems at 6.66 and 26.66 kPa, J. Chem. Eng. Data. 39 (1994) 50–52, doi:10.1021/je00013a014.
- [1987] J. Guo, X. Zheng, J. Zhang, Huagong Xuebao 4 (1983) 27–32.
- [1988] D.V.S. Jain, N.S. Dhar, Excess molar enthalpies of binary mixtures ethylbenzene + propylbenzene, + butylbenzene and + hexylbenzene at 298.15, 308.15 and 318.15 K, Fluid Phase Equilibria 81 (1992) 231–239, doi:10.1016/0378-3812(92)85154-z.
- [1989] J. Linek, V. Fried, J. Pick, Gleichgewicht Flüssigkeit-Dampf XXXIV. System Äthylbenzol-Cumol-Butylbenzol unter atmosphärischem Druck, Collect. Czechoslov. Chem. Commun. 30 (1965) 1358–1365, doi:10.1135/cccc19651358.
- [1990] C.H. Lee, G.D. Holder, Vapor-liquid equilibria in the systems toluene/naphthalene and cyclohexane/naphthalene, J. Chem. Eng. Data. 38 (1993) 320–323, doi:10.1021/je00010a034.
- [1991] K.W. Hutchenson, J.R. Roebbers, M.C. Thies, Vapor-liquid equilibrium for phenanthrene-toluene mixtures at elevated temperatures and pressures, Fluid Phase Equilibria 60 (1990) 309–317, doi:10.1016/0378-3812(90)85060-N.
- [1992] S.Le Roy, E. Behar, P. Ungerer, Vapour-liquid equilibrium data for synthetic hydrocarbon mixtures. Application to modelling of migration from source to reservoir rocks, Fluid Phase Equilibria 135 (1997) 63–82, doi:10.1016/S0378-3812(97)00063-0.
- [1993] S. Malanowski, B. Swiatek, Int. Data Ser. Sel. Data Mix. Ser. A. 22 (1994) 341.
- [1994] S. Malanowski, B. Swiatek, Int. Data Ser. Sel. Data Mix. Ser. A. 22 (1994) 342.
- [1995] S. Laugier, A. Valtz, A. Chareton, D. Richon, H. Renon, RR-82 Vapor-Liquid Equilibria Measurements on the Systems Ethane-Toluene, Res. Rep. RR-82 (1984).
- [1996] Y.-N. Lin, S.-C. Hwang, R. Kobayashi, Vapor-liquid equilibrium of the methane-toluene system at low temperatures, J. Chem. Eng. Data. 23 (1978) 231–234, doi:10.1021/je60078a007.
- [1997] S.-C. Hwang, R. Kobayashi, Dew-point loci for the methane-toluene system, J. Chem. Eng. Data. 22 (1977) 409–410, doi:10.1021/je60075a008.
- [1998] L.R. Field, E. Wilhelm, R. Battino, The solubility of gases in liquids 6. Solubility of N<sub>2</sub>, O<sub>2</sub>, CO, CO<sub>2</sub>, CH<sub>4</sub>, and CF<sub>4</sub> in methylcyclohexane and toluene at 283 to 313 K, J. Chem. Thermodyn. 6 (1974) 237–243, doi:10.1016/0021-9614(74)90175-X.
- [1999] R. Langhorst, Experimentelle Untersuchung der Dampfphase in weitsiedenden Gemischen sowie Aufbau einer Datenbank fuer Phasengleichgewichte, TU Berlin, 1987.
- [2000] S. Srivatsan, W. Gao, K.A.M. Gasem, R.L. Robinson, Solubility of Methane in Toluene at Temperatures from 313 to 423 K at Pressures to 8.9 MPa, J. Chem. Eng. Data. 43 (1998) 623–625, doi:10.1021/je9800151.
- [2001] S.S.-S. Huang, D.B. Robinson, The equilibrium phase properties of selected mesitylene binary systems: Mesitylene–methane and mesitylene–carbon dioxide, Can. J. Chem. Eng. 63 (1985) 126–130, doi:10.1002/cjce.5450630120.
- [2002] G. Stepanova, A. Velikovskii, Gazov Delo 10 (1969) 10–13.
- [2003] J.J. Simnick, H.M. Sebastian, H.M. Lin, K.C. Chao, Gas–liquid equilibrium in mixtures of methane + m-xylene, and methane + m-cresol, Fluid Phase Equilibria 3 (1979) 145–151, doi:10.1016/0378-3812(79)85006-2.
- [2004] H.J. Ng, S.S.S. Huang, D.B. Robinson, Equilibrium phase properties of selected m-xylene binary systems. m-Xylene-methane and m-xylene carbon dioxide, J. Chem. Eng. Data. 27 (1982) 119–122, doi:10.1021/je00028a004.
- [2005] W.F. O'Reilly, T.E. Blumer, K.D. Luks, J.P. Kohn, Vapor-liquid two-phase and vapor-liquid-solid three-phase behavior in three ternary hydrocarbon systems containing methane, J. Chem. Eng. Data. 21 (1976) 220–222, doi:10.1021/je60069a026.
- [2006] H.M. Sebastian, J.J. Simnick, H.-M. Lin, K.-C. Chao, Gas-liquid equilibrium in binary mixtures of methane with tetralin, diphenylmethane, and 1-methylnaphthalene, J. Chem. Eng. Data. 24 (1979) 149–152, doi:10.1021/je60081a005.
- [2007] B. Kaul, Solubilities and Dew-Point Temperature in Hydrocarbon and Coal Processing, University of California, 1977.
- [2008] Ph. Marteau, P. Tobaly, V. Ruffier-Meray, A. Barreau, In situ determination of high pressure phase diagrams of methane-heavy hydrocarbon mixtures using an infrared absorption method, Fluid Phase Equilibria 119 (1996) 213–230, doi:10.1016/0378-3812(95)02982-6.
- [2009] V. Hernandez, J. Gasca, E. Rodriguez, Rev. Inst. Mex. Pet. 10 (1978) 62–69.
- [2010] V. Nazarov, V. Shalygin, VINITI 3707–77 (1977) 7.
- [2011] B. Raju, R. Ranganathan, M. Rao, Thermodynamics of vapor-liquid equilibria. System:(1) benzene- cumene,(2) iso-amyl alcohol- cumene,(3) methanol-methylcyclohexane, Indian Chem. Eng. 5 (1963) 82–90.
- [2012] L. Xia, J. Zhang, J. Fu, Vapor Liquid Phase Equilibria of Binary System of Benzene Isopropylbenzene, Benzene Diisopropylbenzene and Isopropylbenzene Diisopropylbenzene, Hua Hsueh K. Yeh Yu K. Cheng. 48 (1997) 115–118.
- [2013] T. Roscher, R. Wohland, FIZ Rep. (1970) 12151.
- [2014] D.V.S. Jain, R. Chadha, N.S. Dhar, Excess molar enthalpies of (benzene or methylbenzene or ethylbenzene + 2-methylethylbenzene) at the temperatures 298.15 K, 308.15 K, and 318.15 K, J. Chem. Thermodyn. 24 (1992) 1027–1031, doi:10.1016/S0021-9614(05)80013-8.
- [2015] J. Nath, R.B. Yadava, Thermodynamic properties and dielectric constants for binary mixtures of carbon tetrachloride with cumene and mesitylene and of benzene with cumene and mesitylene, Indian J. Chem. 9 (1971) 45–47.
- [2016] G. Chen, X. Yan, S. Han, Huagong Xuebao Chin Ed 45 (1994) 94–101.
- [2017] H.W. Prengle, G. Palm, Thermodynamics of Solutions, Ind. Eng. Chem. 49 (1957) 1769–1774, doi:10.1021/ie50574a046.
- [2018] R.S. Ramalho, Jean. Delmas, Isothermal and isobaric vapor-liquid equilibrium data and excess free energies by the total pressure method. Systems: 2,2,4-trimethylpentane-toluene, cyclohexane-1-butanol, and ethanol-n-heptane, J. Chem. Eng. Data. 13 (1968) 161–164, doi:10.1021/je60037a005.
- [2019] E. Gelus, S. Marple, M.E. Miller, Vapor-Liquid Equilibria of Hydrocarbon Systems above Atmospheric Pressure, Ind. Eng. Chem. 41 (1949) 1757–1761, doi:10.1021/ie50476a055.
- [2020] H. Gardeler, S. Horstmann, A. Tsuboi, S. Toba, J. Rarey, J. Gmehling, Vapor-liquid equilibria at six temperatures from 313.15 K to 402.15 K and excess enthalpy data at 363.15 K and 1.65 MPa for the system toluene + 2,2,4-trimethylpentane (isooctane), ELDATA Int. Electron. J. Phys.-Chem. Data 4 (1998) 1–9.
- [2021] B.S. Harsted, E.S. Thomsen, Excess enthalpies from flow microcalorimetry 3. Excess enthalpies for binary liquid mixtures of aliphatic and aromatic hydrocarbons, carbon tetrachloride, chlorobenzene, and carbon disulphide, J. Chem. Thermodyn. 7 (1975) 369–376, doi:10.1016/0021-9614(75)90175-5.
- [2022] M. Badina, I. Sabylin, M. Kharisov, Investigation and calculation of the liquid-vapor phase equilibrium in the three-component system toluene-2,2-dimethylpentane-ethylbenzene, Zh. Prikl. Khim. 50 (1977) 2478–2480.
- [2023] J.H. Weber, Vapor-Liquid Equilibria at Atmospheric Pressure - Systems 2,2,5-Trimethylhexane-Ethylbenzene and 1-Octene-Ethylbenzene, Ind. Eng. Chem. 48 (1956) 134–136, doi:10.1021/ie50553a039.
- [2024] G.Y. Wang, G.Q. Wang, L. Bao, in: Beijing (1994) 597–599.
- [2025] V.K. Rattan, K. Raju, Heats of mixing of binaries of isopropylbenzene with o-, m-, and p-xylenes at 298.15 K, Indian J. Technol. 29 (1991) 77–78.
- [2026] M.I. Paz-Andrade, S. Castromil, M.C. Baluja, Enthalpies of mixing: n-hexane + o-xylene at 25, 35, and 50 °C, J. Chem. Thermodyn. 2 (1970) 775–777, doi:10.1016/0021-9614(70)90018-2.
- [2027] M.I. Paz Andrade, E. Jimenez, M.C. Baluja, Enthalpies of mixing of the hexane-m-xylene system at 25.0, 35.0, and 50.0 deg, Quim 66 (1970) 955–959.
- [2028] R.L. Arenosa, R.G. Rubio, C. Mendiña, M.D. Peña, Excess enthalpies of ethylbenzene + alkane systems at 25°C. An interpretation in terms of the Prigogine-Flory-Patterson model, J. Solut. Chem. 14 (1985) 345–354, doi:10.1007/BF00646170.
- [2029] P.M. Ghogomu, M. Bouroukba, J. Dellacherie, D. Balesdent, M. Dirand, Calorimetric measurement of molar excess enthalpies of dilute solutions of ethylbenzene + higher n-alkanes, Thermochim. Acta. 302 (1997) 159–164, doi:10.1016/S0040-6031(97)00235-9.
- [2030] E. Wilhelm, A. Inglese, A.H. Roux, J.-P.E. Grolier, Excess enthalpy, excess heat capacity and excess volume of 1,2,4-trimethylbenzene +, and 1-methylnaphthalene + an n-alkane, Fluid Phase Equilibria 34 (1987) 49–67, doi:10.1016/0378-3812(87)85050-1.
- [2031] G. Kortüm, G. Dreesen, H.-J. Freier, Zur Thermodynamik von Flüssigkeitsmischungen verschiedener Molekülgröße, Z. Für Naturforschung A. 8 (1953) 546–555, doi:10.1515/zna-1953-0905.
- [2032] G. Kortüm, H. Schreiber, Theoretische und experimentelle Untersuchungen über die Mischungseffekte von Benzol mit seinen Quasi-Dimeren Diphenyl, o,o'-Ditolyl und Diphenylmethan, Z. Für Naturforschung A. 20 (1965) 1030–1041, doi:10.1515/zna-1965-0807.
- [2033] D.V.S. Jain, R. Chadha, N.S. Dhar, Excess enthalpies of binary mixtures toluene + propylbenzene, + butylbenzene and + hexylbenzene at 298.15, 308.15 and 318.15 K, Fluid Phase Equilibria 102 (1994) 205–210, doi:10.1016/0378-3812(94)87077-2.
- [2034] B.A. Kovalchuk, V.P. Olkhov, O.V. Tsymarnaya, The Heat of Mixing of Dodecane with Aromatic Hydrocarbons, Teplofiz Svoistva Veshchestv Mater 24 (1988) 31–35.
- [2035] A. Aoulmi, M. Bouroukba, R. Solimando, M. Rogalski, Thermodynamics of mixtures formed by polycyclic aromatic hydrocarbons with long chain alkanes, Fluid Phase Equilibria 110 (1995) 283–297, doi:10.1016/0378-3812(95)02759-8.
- [2036] E. Aznar, B. Ruiz, C.Gutiérrez Losa, Excess molar enthalpies at 298.15 K of (cyclohexane + a methylquinoline) and of (benzene + a methylquinoline), J. Chem. Thermodyn. 17 (1985) 1121–1126, doi:10.1016/0021-9614(85)90038-2.
- [2037] D.W. Hissong, W.B. Kay, Critical properties of hydrocarbons. II. correlational studies, Proc. Am. Pet. Inst. Refin. Dep. 48 (1968) 397–463.
- [2038] T.M. Letcher, C. Heyward, W.L. Spiteri, The excess molar enthalpies of cyclopentane + each of six n-alkanes at two temperatures, J. Chem. Thermodyn. 15 (1983) 395–396, doi:10.1016/0021-9614(83)90069-1.
- [2039] A. Inglese, J. Grolier, Excess enthalpy. Cyclopentane-n-heptane system, Int. Data Ser. Sel. Data Mix. Ser. A. (1975) 98–109.
- [2040] K.W. Miller, Solubility of fluorocarbon gases in cyclohexane, J. Phys. Chem. 72 (1968) 2248–2249, doi:10.1021/j100852a070.
- [2041] H.S. Myers, [Vapor- liquid] equilibrium for naphthenes and paraffins, Pet Refin. 36 (1957) 175–178.
- [2042] D.M. Trampe, C.A. Eckert, Calorimetric measurement of partial molar excess enthalpies at infinite dilution, J. Chem. Eng. Data. 36 (1991) 112–118, doi:10.1021/je00001a033.
- [2043] J. Dojcansky, J. Surovy, Chem. Pap. 50 (1996) 258–261.
- [2044] H. Gumpert, H. Koehler, W. Schiller, Wiss Z Tech Hochsch Chem "Carl Schorlemmer" Leuna-Mersebg 15 (1973) 179–187.
- [2045] T. Akimoto, T. Nitta, T. Katayama, Nitrogen solubility and vapor pressure of binary mixed solvents containing benzene, carbon tetrachloride, cyclohex-

- ane and 1-hexane, *J. Chem. Eng. Jpn.* 17 (1984) 637–641, doi:[10.1252/jcej.17.637](https://doi.org/10.1252/jcej.17.637).
- [2046] K. Noda, M. Ohashi, K. Ishida, Isothermal vapor-liquid equilibria for the n-hexane-cyclohexane-tetralin system, *J. Chem. Eng. Data.* 32 (1987) 136–137, doi:[10.1021/je00048a002](https://doi.org/10.1021/je00048a002).
- [2047] H. Yoshikawa, M. Kato, *Kagaku Kogaku Ronbunshu* 18 (1992) 723–728.
- [2048] M.L. Martin, J.C. Youings, Vapour pressures and excess Gibbs free energies of cyclohexane + n-hexane, + n-heptane and + n-octane at 298. 150 K, Aust. *J. Chem.* 33 (1980) 2133–2138, doi:[10.1071/ch9802133](https://doi.org/10.1071/ch9802133).
- [2049] D. Meixner, R.N. Lichtenthaler, Einfluß von ordnungsstrukturen auf die thermodynamischen zustandsgrößen. dampfdrücke binärer alkanmischungen, *Berichte Bunsenges. Für Phys. Chem.* 83 (1979) 567–572, doi:[10.1002/bbpc.19790830606](https://doi.org/10.1002/bbpc.19790830606).
- [2050] J.B. Ott, K.N. Marsh, R.H. Stokes, Excess enthalpies, excess Gibbs free energies, and excess volumes for (cyclohexane + n-hexane), and excess Gibbs free energies and excess volumes for (cyclohexane + methylcyclohexane) at 298.15 and 308.15 K, *J. Chem. Thermodyn.* 12 (1980) 1139–1148, doi:[10.1016/S0021-9614\(80\)80006-1](https://doi.org/10.1016/S0021-9614(80)80006-1).
- [2051] M. Góral, P. Oracz, S. Warycha, Vapour-liquid equilibria: VI. the ternary system acetone - hexane - cyclohexane at 313.15 K, *Fluid Phase Equilibria* 81 (1992) 261–272, doi:[10.1016/0378-3812\(92\)85156-3](https://doi.org/10.1016/0378-3812(92)85156-3).
- [2052] M. Góral, P. Oracz, S. Warycha, Vapour-liquid equilibria: XIII. the ternary system cyclohexane-methanol-hexane at 303.15 K, *Fluid Phase Equilibria* 152 (1998) 109–120, doi:[10.1016/S0378-3812\(98\)00383-5](https://doi.org/10.1016/S0378-3812(98)00383-5).
- [2053] M. Góral, P. Oracz, S. Warycha, Vapour-liquid equilibria: XIV. the ternary system cyclohexane-methanol-hexane at 293.15 K, *Fluid Phase Equilibria* 169 (2000) 85–99, doi:[10.1016/S0378-3812\(00\)00306-X](https://doi.org/10.1016/S0378-3812(00)00306-X).
- [2054] J. Gmehling, B. Meents, Excess enthalpy. Cyclohexane-hexane system, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1992) 144–145.
- [2055] S. D'Avila, J. Carioca, Measurement of activity coefficients at infinite dilution by inert gas stripping and gas chromatography, *Priv. Commun. Braz.* (1996).
- [2056] C. Keil, H. Bittrich, Mixing calorimetry without vapor space, *Z. Phys. Chem. Leipz.* 248 (1971) 65–73.
- [2057] J. Gmehling, Excess enthalpies for 1,1,1-trichloroethane with alkanes, ketones, and esters, *J. Chem. Eng. Data.* 38 (1993) 143–146, doi:[10.1021/je00009a036](https://doi.org/10.1021/je00009a036).
- [2058] K.N. Marsh, R.H. Stokes, Enthalpies of mixing of n-hexane + cyclohexane at 25 °C, *J. Chem. Thermodyn.* 1 (1969) 223–225, doi:[10.1016/0021-9614\(69\)90060-3](https://doi.org/10.1016/0021-9614(69)90060-3).
- [2059] M.B. Ewing, K.N. Marsh, The enthalpy of mixing of n-hexane + cyclohexane at 288.15 and 318.15 K, *J. Chem. Thermodyn.* 2 (1970) 295–296, doi:[10.1016/0021-9614\(70\)90094-7](https://doi.org/10.1016/0021-9614(70)90094-7).
- [2060] T. Letcher, J. Sack, The excess enthalpy of mixing of some hydrocarbon mixtures, *J. Afr Chem Inst* 28 (1975) 316–320.
- [2061] P. Alessi, I. Kikic, V. Longo, The heats of mixing of paraffin - cycloparaffin systems, *Univ Studi Trieste Fac Ing Ist Chim Appl* 49 (1974) 1–10.
- [2062] S. Murakami, G.C. Benson, An isothermal dilution calorimeter for measuring enthalpies of mixing, *J. Chem. Thermodyn.* 1 (1969) 559–572, doi:[10.1016/0021-9614\(69\)90016-0](https://doi.org/10.1016/0021-9614(69)90016-0).
- [2063] J.-P.E. Grolier, G.C. Benson, P. Picker, Enthalpies of mixing of organic liquids measured directly as a function of composition by means of scanning dynamic flow microcalorimetry, *J. Chem. Thermodyn.* 7 (1975) 89–95, doi:[10.1016/0021-9614\(75\)90085-3](https://doi.org/10.1016/0021-9614(75)90085-3).
- [2064] E. Grolier Jean-Pierre, Détermination des enthalpies de mélange de non-electrolytes à l'aide du microcalorimètre picker à écoulement continu, *Thermochim. Acta.* 16 (1976) 27–38, doi:[10.1016/0040-6031\(76\)85039-3](https://doi.org/10.1016/0040-6031(76)85039-3).
- [2065] H. Huemer, E. Platzer, K. Rehak, Test measurements and analysis of errors for a new equipment for the determination of excess-heat data, *Thermochim. Acta.* 187 (1991) 95–112, doi:[10.1016/0040-6031\(91\)87185-Y](https://doi.org/10.1016/0040-6031(91)87185-Y).
- [2066] K. Marsh, Excess enthalpy, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1973) 16.
- [2067] B.I. Mattingley, Y.P. Handa, D.V. Fenby, Aromatic fluorocarbon mixtures 7. excess enthalpies of hexafluorobenzene + triethylamine, + acetone, + diethyl ether, and + dimethyl sulphoxide, *J. Chem. Thermodyn.* 7 (1975) 169–173, doi:[10.1016/0021-9614\(75\)90265-7](https://doi.org/10.1016/0021-9614(75)90265-7).
- [2068] M.L. McGlashan, H.F. Stoeckli, A flow calorimeter for enthalpies of mixing the enthalpy of mixing of n-hexane + cyclohexane at 298.15 K, *J. Chem. Thermodyn.* 1 (1969) 589–594, doi:[10.1016/0021-9614\(69\)90019-6](https://doi.org/10.1016/0021-9614(69)90019-6).
- [2069] K. Marsh, Excess enthalpy, *Int. Data Ser. Sel. Data Mix. Ser. A.* (1973) 21–23.
- [2070] H. Arm, P. Bucher, Calorimeter for determining enthalpies of mixing. enthalpies of mixing of the binary system n-hexane + cyclohexane at 25 °C, *Chimia* 27 (1973) 79–81.
- [2071] J.J. Christensen, L.D. Hansen, D.J. Eatough, R.M. Izatt, R.M. Hart, Isothermal high pressure flow calorimeter, *Rev. Sci. Instrum.* 47 (1976) 730–734, doi:[10.1063/1.1134723](https://doi.org/10.1063/1.1134723).
- [2072] A. Ahmed, Enthalpy of mixing of n-hexane and cyclohexane, *J. Chem. Soc. Faraday Trans. 1 Phys. Chem. Condens. Phases.* 69 (1973) 387–389, doi:[10.1039/F19736900387](https://doi.org/10.1039/F19736900387).