

ORTJ0933

Int. DATA Ser., Sel. Data Mixtures, Ser. A 1993, 21(3), 232-245

Excess enthalpies of 1,5-diiodopentane or 1,6-diiodohexane + some normal alkane (C5-C17) mixtures

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INTRODUCTION

As a continuation of our systematic measurements of the thermodynamic properties of mixtures (1), the present paper reports excess enthalpies for 12 mixtures of alpha, omega-diiodoalkanes (1,5-diiodopentane or 1,6-diiodohexane) + n-alkanes (pentane, heptane, nonane, undecane, tridecane, pentadecane, or heptadecane) measured at 298.15 K and atmospheric pressure with a Calvet type microcalorimeter.

The literature includes a few studies of the properties of 1-iodoalkane + alkane mixtures (see ref. 2). No excess enthalpy measurements have been made on alpha, omega-diiodoalkanes + alkanes.

The main purpose of this study is to determine interaction parameters applicable to the various group-contribution models and to investigate the "proximity effect" between the I-atoms. The lower alpha, omega-diiodoalkanes being either solid or only partially miscible with n-alkanes at room temperature, the present measurements will be augmented by solid-liquid equilibrium, liquid-liquid equilibrium, and enthalpy of mixing measurements at higher temperatures.

*Author to whom correspondence should be addressed.

REFERENCES

1. Ortega, J.; Placido, J. *Int. DATA Ser., Sel. Data Mixtures, Ser. A 1993, 21, 1.*
2. Soriano, M. J.; Velasco, I.; Otin, S.; Kehiaian, H.V. *Fluid Phase Equilib.* 1989, 45, 205.

Published by Thermodynamics Research Center

Components: 1. 1,5-Diiodopentane, $C_5H_{10}I_2$
2. Pentane, C_5H_{12}

State: Binary system, single-phase liquid; pure components, both liquid

Variables: H^E , molar excess enthalpy x_1 , mole fraction of component 1Parameters: T , temperatureConstants: P , pressureMethod: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_1 ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.

Edited by: Kebhian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

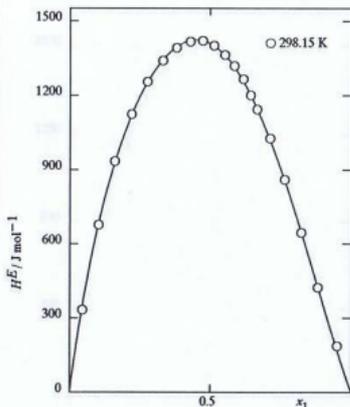
SOURCE OF DATA

Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P , atm. $T/K = 298.15$

x_1	$H^E/J \text{ mol}^{-1}$					
0.0444	331.9					
0.1021	674.9					
0.1599	933.2					
0.2194	1123.2					
0.2769	1254.0					
0.3318	1339.4					
0.3813	1390.0					
0.4295	1415.1					
0.4741	1418.5					
0.5150	1400.0					
0.5529	1362.0					
0.5871	1317.9					
0.6193	1264.6					
0.6458	1199.1					
0.6684	1141.9					
0.7147	1024.7					
0.7651	858.1					
0.8239	642.5					
0.8827	422.2					
0.9503	185.2					

Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_a and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$J \text{ mol}^{-1}$						
298.15	5633 (11)	-1133 (37)	-210 (120)	-1550 (100)	510 (220)	6.1	13

The std. deviations σa_i of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [\sum (H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

 N , no. of direct exptl. values; n , no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm^3) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2169.16$; $n(D, 298.15 \text{ K}) = 1.5987$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material of stated GLC purity > 99.5 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 621.31$; $n(D, 298.15 \text{ K}) = 1.3547$.
Materials were degassed ultrasonically before use.Errors: $\delta T(\text{reproducibility})/K = 0.02$; $\delta T(\text{IPTS-68})/K = 0.02$; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 1a*, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
3. McGlashan, M. L.; Stoeckli, H. F. *J. Chem. Thermodyn.* 1969, 1, 589.
4. Diaz Peña, M.; Menduñía, C. *J. Chem. Thermodyn.* 1974, 6, 387.

SELECTED DATA ON MIXTURES
International DATA Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,5-Diiodopentane, $C_5H_{10}I_2$

2. Heptane, C_7H_{16}

State: Binary system, single-phase liquid; pure components, both liquid

Variables: H^E , molar excess enthalpy

x_2 , mole fraction of component 1

Parameters: T , temperature

Constants: P , pressure

Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_1 ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
 Edited by: Kehiaian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

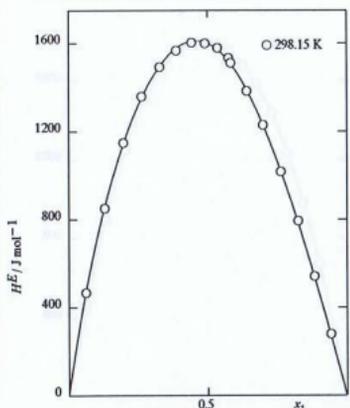
Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.

$T/K = 298.15$

x_1	$H^E / J \text{ mol}^{-1}$						
0.0616	466.3						
0.1305	849.9						
0.1973	1149.7						
0.2641	1359.3						
0.3287	1493.7						
0.3879	1568.3						
0.4434	1603.2						
0.4918	1600.1						
0.5364	1579.7						
0.5766	1534.0						
0.5845	1511.6						
0.6426	1383.9						
0.7006	1229.1						
0.7631	1018.2						
0.8259	792.3						
0.8841	541.0						
0.9417	278.5						



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$J \text{ mol}^{-1}$						
298.15	6404 (14)	-1084 (53)	-350 (170)	-800 (140)	760 (300)	7.9	14

The std. deviations σ_d of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [\sum (H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

N , no. of direct exptl. values; n , no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm^3) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2169.16$; $n(D, 298.15 \text{ K}) = 1.5987$.
 2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material of stated GLC purity > 99.5 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 679.46$; $n(D, 298.15 \text{ K}) = 1.3851$.
 Materials were degassed ultrasonically before use.

Errors: δT (reproducibility)/K = 0.02; δT (IPTS-68)/K = 0.02; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

REFERENCES

1. Int. DATA Ser., Ser. A, Guideline 1a, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
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4. Diaz Peña, M.; Menduña, C. *J. Chem. Thermodyn.* 1974, 6, 387.

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*Ser. A. Thermodynamic Properties of Non-reacting Binary Systems of Organic Substances

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SELECTED DATA ON MIXTURES
International Data Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,5-Dilodopentane, C₅H₁₀L₂
2. Nonane, C₉H₂₀
State: Binary system, single phase liquid; pure components, both liquid
Variables: H^E , molar excess enthalpy
Parameters: x_2 , mole fraction of component 1
Constants: T , temperature
Method: P , pressure
Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_1 ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Físicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
Edited by: Kehianin, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

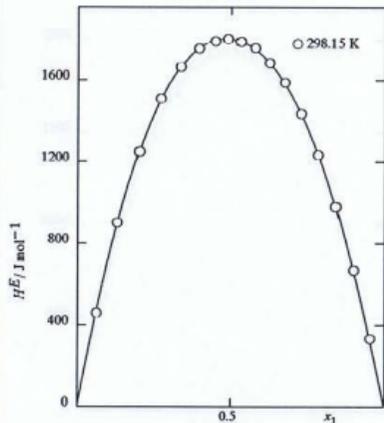
Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.

$T/K = 298.15$

x_1	$H^E/J \text{ mol}^{-1}$						
0.0627	457.4						
0.1314	897.8						
0.2021	1247.6						
0.2706	1505.2						
0.3349	1660.6						
0.3947	1750.4						
0.4491	1785.1						
0.4904	1795.9						
0.5307	1782.6						
0.5759	1750.9						
0.6246	1680.5						
0.6742	1582.7						
0.7280	1432.6						
0.7843	1231.9						
0.8415	976.4						
0.8992	665.8						
0.9528	330.9						



SMOOTHING EQUATION

$$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	J mol ⁻¹						
298.15	7181.0 (6.4)	-423 (23)	1403 (72)	152 (60)	-1178 (120)	3.4	5.7

The std. deviations σ_i of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [\sum (H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

N , no. of direct exptl. values; n , no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm³) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2169.16$; $n(D, 298.15 \text{ K}) = 1.5987$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material of stated GLC purity > 99 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 713.85$; $n(D, 298.15 \text{ K}) = 1.4033$.
Materials were degassed ultrasonically before use.

Errors: $\delta T(\text{reproducibility})/K = 0.02$; $\delta T(1P1S-68)/K = 0.02$; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 1a*, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
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1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,5-Dilodopentane, C₅H₁₀O₂

2. Undecane, C₁₁H₂₄

State: Binary system, single-phase liquid; pure components, both liquid

Variables: H^E, molar excess enthalpy

x₂, mole fraction of component 1

Parameters: T, temperature

Constants: P, pressure

Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x₁; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.

Edited by: Kehiaian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

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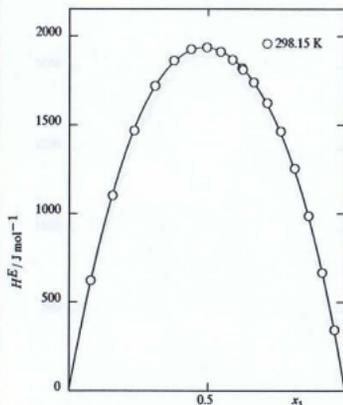
Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P, atm.

T/K = 298.15

x ₁	H ^E /J mol ⁻¹						
0.0782	620.0						
0.1581	1099.4						
0.2366	1466.6						
0.3095	1716.3						
0.3770	1859.3						
0.4394	1923.9						
0.4955	1934.3						
0.5448	1908.5						
0.5890	1865.3						
0.6239	1817.7						
0.6276	1807.9						
0.6672	1736.6						
0.7159	1620.2						
0.7655	1461.2						
0.8159	1250.7						
0.8668	982.6						
0.9167	663.9						
0.9608	340.4						



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H_{\text{calc}}^E = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d and max. deviation δ_m, detid. by least-squares anal.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	J mol ⁻¹						
298.15	7727 (15)	-291 (51)	1580 (170)	750 (130)	-450 (290)	7.8	13

The std. deviations σ_d of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H_{\text{calc}}^E - H^E|; \sigma_d = [\sum (H_{\text{calc}}^E - H^E)^2 / (N - n)]^{1/2}$$

N, no. of direct exptl. values; n, no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm³) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

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Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; ρ₁(298.15 K)/kg m⁻³ = 2169.16; n(D, 298.15 K) = 1.5987.

2. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material of stated GLC purity > 97 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; ρ₂(298.15 K)/kg m⁻³ = 736.80; n(D, 298.15 K) = 1.4154. Materials were degassed ultrasonically before use.

Errors: δT(reproducibility)/K = 0.02; δT(IPTS-68)/K = 0.02; δx₁ < 0.0005; δH^E/H^E < 0.02 (over central range of concn.).

REFERENCES

1. Int. DATA Ser., Ser. A. Guideline 1a, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
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SELECTED DATA ON MIXTURES
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1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

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2. Tridecane, C₁₃H₂₈
State: Binary system, single-phase liquid; pure components, both liquid
Variables: H^E, molar excess enthalpy
x₂, mole fraction of component 1
Parameters: T, temperature
Constants: P, pressure
Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x₁; ref. 1

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SOURCE OF DATA

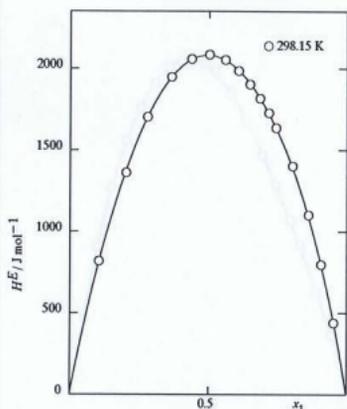
Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P, atm.

T/K = 298.15

x ₁	H ^E /J mol ⁻¹					
0.1048	816.9					
0.2021	1360.6					
0.2796	1701.2					
0.3647	1946.0					
0.4375	2057.7					
0.5020	2083.5					
0.5585	2051.1					
0.6073	1984.1					
0.6491	1901.4					
0.6855	1813.9					
0.7171	1726.6					
0.7441	1634.1					
0.8046	1402.0					
0.8622	1101.2					
0.9087	794.4					
0.9532	437.2					



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H_{\text{calc}}^E = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq. std. deviation σ_a and max. deviation δ_m detd. by least-squares anal.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _a	δ _m
	J mol ⁻¹						
298.15	8319 (17)	-128 (55)	680 (180)	1080 (150)	790 (320)	7.8	13

The std. deviations σ_a of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H_{\text{calc}}^E - H^E|; \sigma_a = [\sum (H_{\text{calc}}^E - H^E)^2 / (N - n)]^{1/2}$$

N, no. of direct exptl. values; n, no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm³) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedures: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; ρ₁(298.15 K)/kg m⁻³ = 2169.16; n(D, 298.15 K) = 1.5987.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puris' grade material of stated GLC purity > 99.5 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; ρ₂(298.15 K)/kg m⁻³ = 752.79; n(D, 298.15 K) = 1.4238.
Materials were degassed ultrasonically before use.

Errors: δT(reproducibility)/K = 0.02; δT(IPTS-68)/K = 0.02; δx₁ < 0.0005; δH^E/H^E < 0.02 (over central range of concn.).

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 1a*, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
3. McOlashan, M. L.; Stoeckli, H. F. *J. Chem. Thermodyn.* 1969, 1, 589.
4. Diaz Peña, M.; Menduña, C. *J. Chem. Thermodyn.* 1974, 6, 387.

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Received: May 5, 1993

*Ser. A. Thermodynamic Properties of Non-reacting Binary Systems of Organic Substances

Published: July 31, 1993

SELECTED DATA ON MIXTURES

International DATA Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,6-Dihydrohexane, C₆H₁₂ 2. Pentane, C₅H₁₂
 State: Binary system, single-phase liquid; pure components, both liquid
 Variables: H^E, molar excess enthalpy
 x₁, mole fraction of component 1
 Parameters: T, temperature
 Constants: P, pressure
 Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x₁; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
 Edited by: Kehiaian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

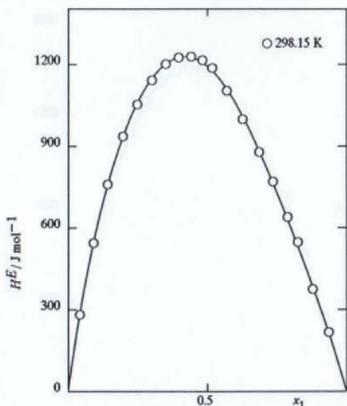
Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P, atm.

T/K = 298.15

x ₁	H ^E /J mol ⁻¹				
0.0423	279.6				
0.0907	543.4				
0.1429	757.4				
0.1971	932.9				
0.2499	1050.7				
0.3019	1138.5				
0.3516	1197.8				
0.3976	1222.2				
0.4417	1226.3				
0.4826	1212.0				
0.5177	1183.0				
0.5697	1100.9				
0.6275	995.9				
0.6872	876.3				
0.7366	766.3				
0.7884	637.1				
0.8251	546.2				
0.8799	372.7				
0.9357	216.0				



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H_{\text{calc}}^E = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_a and max. deviation δ_m detd. by least-squares anal.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _a	δ _m
	J mol ⁻¹						
298.15	4764 (14)	-1707 (47)	-300 (150)	-120 (120)	1160 (260)	7.4	12

The std. deviations σ_a of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H_{\text{calc}}^E - H^E|; \sigma_a = [\sum (H_{\text{calc}}^E - H^E)^2 / (N - n)]^{1/2}$$

N, no. of direct exptl. values; n, no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm³) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; ρ₁(298.15 K)/kg m⁻³ = 2034.19; n(D, 298.15 K) = 1.5837.
 2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material of stated GLC purity > 99.5 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; ρ₂(298.15 K)/kg m⁻³ = 621.31; n(D, 298.15 K) = 1.3547.
 Materials were degassed ultrasonically before use.

Errors: δT(reproducibility)/K = 0.02; δT(IPTS-68)/K = 0.02; δx₁ < 0.0005; δH^E/J mol⁻¹ < 0.02 (over central range of concn.).

REFERENCES

1. Int. DATA Ser., Ser. A, Guideline 1a, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
3. McGlashan, M. L.; Stoeckli, H. F. *J. Chem. Thermodyn.* 1969, 1, 589.
4. Diaz Peña, M.; Menduina, C. *J. Chem. Thermodyn.* 1974, 6, 387.

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Int. DATA Ser., Sel. Data Mixtures, Ser. A 1993, 21 (3), 232-245

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SELECTED DATA ON MIXTURES

International DATA Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,6-Diiodohexane, $C_6H_{12}I_2$
 2. Heptane, C_7H_{16}
State: Binary system, single-phase liquid; pure components, both liquid
Variables: H^E , molar excess enthalpy
 x_1 , mole fraction of component 1
Parameters: T , temperature
Constants: P , pressure
Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_1 ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
Edited by: Kéchiaian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

Ortega, J.; Plácido, J. (University of Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

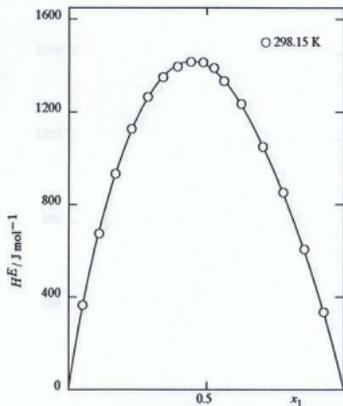
DIRECT EXPERIMENTAL VALUES

Notes: P , atm.

$T/K = 298.15$

x_1 | $H^E/J \text{ mol}^{-1}$

x_1	$H^E/J \text{ mol}^{-1}$						
0.0515	363.9						
0.1109	674.3						
0.1696	931.9						
0.2290	1127.5						
0.2875	1263.8						
0.3427	1350.3						
0.3949	1395.9						
0.4427	1414.8						
0.4874	1414.3						
0.5268	1389.5						
0.5631	1332.3						
0.6263	1234.1						
0.7054	1048.9						
0.7786	851.6						
0.8556	605.2						
0.9268	334.4						



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	J mol ⁻¹						
298.15	5577 (16)	-1297 (37)	416 (81)			10	18

The std. deviations σ_i of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [2(H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

N , no. of direct expl. values; n , no. of coeffs. a_i

All direct expl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm³) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2034.19$; $n(D, 298.15 \text{ K}) = 1.5837$.
 2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puris' grade material of stated GLC purity > 99.5 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 679.46$; $n(D, 298.15 \text{ K}) = 1.3851$.
 Materials were degassed ultrasonically before use.

Errors: $\delta T(\text{reproducibility})/K = 0.02$; $\delta T(\text{IPTS-68})/K = 0.02$; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

REFERENCES

1. Int. DATA Ser., Ser. A, *Guideline 1a*, 1973.
2. Ortega, J.; Gonzales, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
3. McGlashan, M. L.; Stoeckli, H. F. *J. Chem. Thermodyn.* 1969, 1, 589.
4. Diaz Peña, M.; Mendiúña, C. *J. Chem. Thermodyn.* 1974, 6, 387.

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Published: July 31, 1993

SELECTED DATA ON MIXTURES
International Data Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,6-Diiodohexane, $C_6H_{12}I_2$
2. Nonane, C_9H_{20}
State: Binary system, single-phase liquid; pure components, both liquid
Variables: H^E , molar excess enthalpy
 x_i , mole fraction of component i
Parameters: T , temperature
Constants: P , pressure
Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_i ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
Edited by: Kchliatan, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

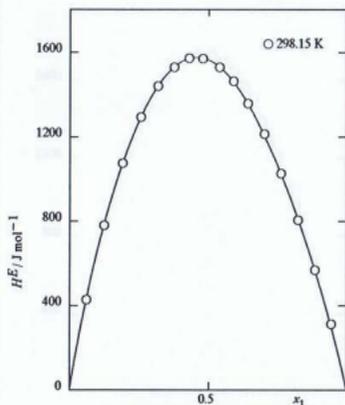
Ortega, J.; Plácido, J. (University of Las Palmas of Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.

$T/K = 298.15$

x_1	$H^E/J \text{ mol}^{-1}$					
0.0597	425.7					
0.1241	779.0					
0.1894	1072.3					
0.2559	1292.1					
0.3178	1437.8					
0.3756	1525.7					
0.4302	1569.7					
0.4791	1566.7					
0.5393	1526.3					
0.5893	1460.8					
0.6430	1356.4					
0.7026	1210.2					
0.7628	1022.6					
0.8241	802.3					
0.8859	564.9					
0.9437	310.7					



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq. std. deviation σ_a and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$J \text{ mol}^{-1}$						
298.15	6243.6 (8.8)	-1145 (30)	-306 (96)	119 (77)	1040 (160)	4.4	7.7

The std. deviations σa_i of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [\sum (H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

N , no. of direct exptl. values; n , no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm^3) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2034.19$; $n(D, 298.15 \text{ K}) = 1.5837$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material of stated GLC purity > 99 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 713.85$; $n(D, 298.15 \text{ K}) = 1.4033$.
Materials were degassed ultrasonically before use.

Error: $\delta T(\text{reproducibility})/K = 0.02$; $\delta T(\text{IPTS-68})/K = 0.02$; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 1a*, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
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4. Diaz Peña, M.; Mendiña, C. *J. Chem. Thermodyn.* 1974, 6, 387.

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Published: July 31, 1993

SELECTED DATA ON MIXTURES
International Data Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

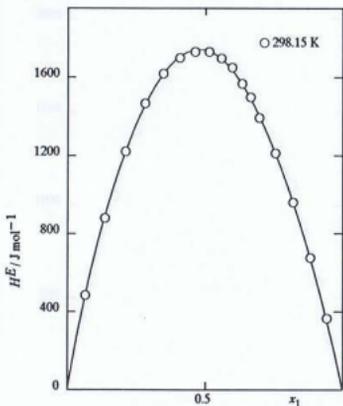
Components: 1. 1,6-Diiodohexane, $C_6H_{12}I_2$
2. Undecane, $C_{11}H_{24}$
State: Binary system, single-phase liquid; pure components, both liquid
Variables: H^E , molar excess enthalpy
Parameters: x_2 , mole fraction of component 1
Parameters: T , temperature
Constants: P , pressure
Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_1 ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Físicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
Edited by: Kehiaian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

Ortega, J.; Plácido, J. (University of Las Palmas of Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

Notes: P , atm.		DIRECT EXPERIMENTAL VALUES				
$T/K = 298.15$						
x_1	$H^E/J \text{ mol}^{-1}$					
0.0645	482.4					
0.1362	876.0					
0.2098	1218.9					
0.2814	1464.2					
0.3464	1616.0					
0.4068	1694.6					
0.4620	1727.2					
0.5132	1726.7					
0.5580	1693.5					
0.5981	1646.7					
0.6339	1565.1					
0.6656	1493.6					
0.6973	1391.3					
0.7566	1208.6					
0.8215	955.7					
0.8841	672.7					
0.9434	362.0					



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

T/K	SMOOTHING EQUATION						
	$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$						
	Coeffs. a_i in the smoothing eq., std. deviation σ_d and max. deviation δ_m detd. by least-squares anal.						
	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$J \text{ mol}^{-1}$						
298.15	6939 (15)	-667 (52)	-380 (170)	-40 (140)	1100 (300)	8.0	13

The std. deviations σ_i of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [2\sum(H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

N , no. of direct exptl. values; n , no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm^3) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2034.19$; $n(D, 298.15 \text{ K}) = 1.5837$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) "purum" grade material of stated GLC purity > 97 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 736.80$; $n(D, 298.15 \text{ K}) = 1.4154$.
Materials were degassed ultrasonically before use.

Errors: δT (reproducibility)/K = 0.02; δT (IPTS-68)/K = 0.02; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 1a*, 1973.
2. Ortega, J.; Gonzalez, E.; Matos, J. S.; Legido, J. L. *J. Chem. Thermodyn.* 1992, 24, 15.
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Received: May 5, 1993

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SELECTED DATA ON MIXTURES
International Data Series*

1a. EXCESS ENTHALPY

The Texas A&M University System, College Station, TX 77843-3111

Published by Thermodynamics Research Center

Components: 1. 1,6-Dihydrohexane, C_6H_{12}
2. Tridecane, $C_{13}H_{28}$
State: Binary system, single-phase liquid; pure components, both liquid
Variables: H^E , molar excess enthalpy
 x_2 , mole fraction of component 1
Parameters: T , temperature
Constants: P , pressure
Method: Direct calorimetric measurement of the enthalpy of mixing at constant T and P and variable x_1 ; ref. 1

Author(s): Ortega, J. (Universidad de Las Palmas de Gran Canaria, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Plácido, J.
Edited by: Kehiaian, H. V. (Institut de Topologie et de Dynamique des Systèmes, Université Paris VII, CNRS, 1, Rue Guy de la Brosse, 75005 Paris, France)

SOURCE OF DATA

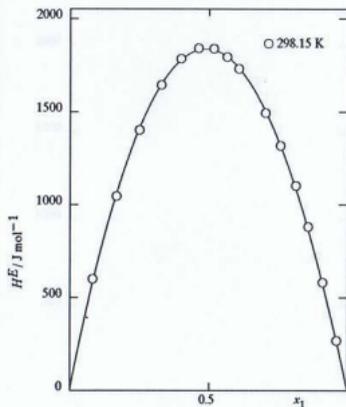
Ortega, J.; Plácido, J. (University of Las Palmas of Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.

$T/K = 298.15$

x_1	$H^E / J \text{ mol}^{-1}$						
0.0814	596.7						
0.1672	1042.8						
0.2503	1399.7						
0.3277	1640.6						
0.3986	1781.9						
0.4620	1840.1						
0.5172	1836.8						
0.5653	1792.8						
0.6078	1728.2						
0.7056	1491.6						
0.7586	1314.9						
0.8143	1100.4						
0.8596	878.6						
0.9112	578.4						
0.9611	265.9						



Points, direct experimental H^E values; curves, H^E_{calc} calculated from the smoothing equation.

SMOOTHING EQUATION

$$H^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$J \text{ mol}^{-1}$						
298.15	7337 (20)	-293 (43)	133 (94)			11	23

The std. deviations σ_i of the coeffs. a_i are given in parentheses

$$\delta_m = \max |H^E_{\text{calc}} - H^E|; \sigma_d = [\sum (H^E_{\text{calc}} - H^E)^2 / (N - n)]^{1/2}$$

N , no. of direct exptl. values; n , no. of coeffs. a_i

All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Calvet type microcalorimeter, model MS-80D (SETARAM, Lyon, France) with stainless steel batch mixing cell (vol. ca. 8 cm^3) and with negligible vapor phase, described in ref. 2. Microcalorimeter calibrated by Joule effect after each measurement. Energies measured by integrating the thermograms.

Procedure: Calibration, filling, and operation described in ref. 2. Cell filled with known masses of pure components. Check measurements on cyclohexane + hexane and benzene + heptadecane, in agreement to within 1% (over central range of concn.) with the data reported in refs. 3 and 4.

Materials: 1. Aldrich Chem. Co., Inc. (Milwaukee, WI, USA) material, of stated purity > 97 mole %, dried over mol. sieve Type 3A (ref. 69828, from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 2034.19$; $n(D, 298.15 \text{ K}) = 1.5837$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material of stated GLC purity > 99.5 mole %, dried over mol. sieve Type 3A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 752.79$; $n(D, 298.15 \text{ K}) = 1.4238$.
Materials were degassed ultrasonically before use.

Errors: δT (reproducibility)/K = 0.02; δT (IPTS-68)/K = 0.02; $\delta x_1 < 0.0005$; $\delta H^E/H^E < 0.02$ (over central range of concn.).

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