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Pressure and Temperature Dependence of the Speed of Sound and Related Properties in Normal Octadecane and Nonadecane

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The speed of sound was mesured in liquid *n*-octadecane and *n*-nonadecane using a pulse technique operating at 3 MHz. The measurements were carried out at pressures up to 150 MPa in the temperature range from 313 to 383 K. The experimental results combined with atmospheric density measurements were then used to evaluate volumetric properties such as the density and the isentropic and isothermal compressibilities up to 150 MPa in the same range of temperature. The density data were fitted with a six-parameter modified Tait equation within the experimental uncertainty.

KEY WORDS: compressibility; density; nonadecane; octadecane; pressure; speed of sound.

1. INTRODUCTION

Growing interest is currently being shown in marketing the heavy fractions of petroleum fluids, in other words, components with high molecular weights, which are often not separated with regard to their compositional analysis. However, the development of models to predict the thermodynamic behavior of these heavy fractions is hindered by a major difficulty: the scarcity, or even the total absence, of experimental data on the hydrocarbons of which they are composed. It can readily be observed that, for the chemical families which make up the majority of these fluids (alkanes, aromatics, naphthenes), most of the work has focused on the most common substances in the homologous series. It is therefore necessary to conduct

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specific experiments on heavy hydrocarbons to set up a base which can then be used to define new models specially adapted to these complex mixtures. With this aim in mind, an investigation was carried out on pure hydrocarbons with more than 16 carbon atoms, as hexadecane is the crucial point beyond which data in the literature become very fragmentary.

This paper describes the behavior of the sound velocity c, measured between pressures of 0.1 and 150 MPa and temperatures of 313.15 and 383.15 K, for liquid *n*-octadecane (C_{18}) and *n*-nonadecane (C_{19}). When measurements of this property are carried out over a sufficiently wide range of pressures (as is the case in this work), the sound velocity data can be integrated so as to generate other thermophysical properties (including density), provided that an appropriate set of initial conditions is available. These include knowledge of the density and the heat capacity C_p at a reference pressure (the most convenient being atmospheric pressure). As these additional measurements have already been performed, we were able to deduce, by means of numerical integration algorithms which have already been tested on various occasions [1, 2], the behavior up to $P = 150$ MPa of the following properties: density ρ, and isentropic compressibility k_S, and isothermal compressibility k_T.

2. EXPERIMENTAL

The samples of *n*-octadecane and *n*-nonadecane were supplied by Fluka; they were used without any further treatment, the purity of each of them being 99% in mass, as confirmed by chromatographic analysis and verification carried out before any of the measurements.

The apparatus used to measure the ultrasonic velocity as a function of temperature and pressure was a pulse echo device comprising two piezoelectric transducers with the same resonance frequency (3 MHz); the essential features of this experimental setup are extensively described in a previous paper [1]. The speed of sound was deduced from the measurement by transmission and reflection [3] of the transit time of the acoustic wave through the sample in the liquid state. The pathlength, which is corrected for the effects of pressure and temperature, was calibrated with the speed-of-sound values of water [4–6]. Different tests performed with hexane [7] and heptane [2] have shown that the uncertainty of the ultrasonic speed measurements is better than 0.1%. The temperature measurements were carried out by means of a platinum resistance thermometer connected to an AOIP standard thermometer. The pressure was measured by an HBM P3M gauge which was previously checked against a deadweight tester (Bundenberg brand) to an uncertainty of better than 0.02%.

3. MEASUREMENTS

The speed of sound c was measured along eight isotherms ranging from 313.15 to 383.15 K using a 10 K interval in the pressure range from atmospheric to the melting pressure or up to 150 MPa for the higher isotherms; the pressure steps adopted during the experiments were 5 and 10 MPa, respectively, for the lower and higher isotherms. The results are summarized for the two paraffins in Tables I and II and are plotted as a function of temperature and pressure in Figs. 1 and 2, respectively. The

Table I. Speed of Sound c ($\mathrm{m \cdot s^{-1}}$) of Normal Octadecane

	T (K)							
P (MPa)	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1013	1305.9	1269.9	1235.1	1200.3	1166.2	1132.8	1100.2	1067.0
5.00	1333.3	1298.2	1264.2					
10.00	1360.1	1326.4	1293.6	1261.4	1229.0	1198.3	1167.8	1137.5
15.00	1386.5	1353.3	1321.2					
20.00	1411.3	1379.3	1347.0	1316.6	1286.7	1257.6	1229.3	1200.7
25.00	1435.4	1403.9	1373.2					
30.00	1459.2	1427.7	1397.7	1367.8	1339.2	1311.8	1284.8	1257.9
35.00	1481.5	1451.7	1421.4					
39.95	1503.3	1473.6	1444.4	1416.1	1388.5	1361.9	1335.4	1310.2
44.95	1524.4	1495.3	1466.4					
49.95	1545.0	1516.4	1487.9	1460.6	1434.3	1407.8	1383.7	1359.1
54.95		1536.7	1508.8					
59.90		1556.4	1529.0	1502.6	1476.8	1453.0	1427.8	1404.2
64.90		1575.7	1549.2					
69.90		1594.9	1568.1	1542.4	1517.4	1493.6	1469.9	1446.4
74.85		1613.9	1587.3					
79.85		1631.6	1605.6	1580.0	1556.2	1532.5	1509.6	1487.3
84.85		1649.1	1623.3					
89.80		1666.6	1641.0	1616.0	1592.9	1569.7	1547.5	1525.6
94.80		1683.5	1658.1					
99.75			1675.0	1650.6	1627.9	1605.5	1583.9	1562.2
104.75			1691.7					
109.70			1707.8	1684.0	1661.4	1639.8	1618.2	1597.4
114.70			1723.6					
119.70			1739.2	1715.8	1694.0	1672.4	1651.5	1630.7
124.65			1754.1					
129.65			1769.7	1747.3	1725.2	1704.2	1683.3	1663.1
134.60			1784.4					
139.60			1799.1	1776.2	1755.7	1734.6	1714.0	1694.3
144.55			1813.6					
149.55				1804.5	1784.0	1763.8	1744.0	1724.0

Table II. Speed of Sound c (m.s^{-1}) of Normal Nonadecane

	T (K)							
P (MPa)	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
0.1013	1314.6	1279.5	1244.2	1209.9	1176.2	1143.1	1110.6	1079.8
5.00	1342.2	1308.8	1273.5					
10.00	1369.7	1335.0	1302.1	1270.3	1238.6	1207.5	1177.7	1148.0
15.00	1395.0	1363.0	1329.3					
20.00	1419.8	1387.2	1356.4	1325.3	1295.6	1266.5	1238.0	1209.9
25.00	1443.0	1412.0	1381.0					
30.00	1466.7	1435.5	1405.5	1376.3	1348.4	1319.9	1292.5	1265.8
35.00	1488.9	1459.0	1429.2					
39.95		1481.0	1451.6	1423.4	1396.2	1369.6	1343.5	1318.7
44.95		1502.5	1473.6					
49.95		1523.1	1495.2	1467.9	1441.7	1415.9	1391.3	1366.3
54.95		1543.6	1515.8					
59.90		1563.1	1535.9	1509.4	1484.2	1459.5	1435.1	1411.1
64.90		1582.4	1555.5					
69.90		1601.3	1574.8	1548.7	1523.8	1500.1	1476.9	1453.3
74.85		1619.8	1593.5					
79.85		1637.5	1611.8	1585.9	1562.4	1538.7	1516.1	1494.0
84.85		1654.3	1629.7					
89.80			1647.4	1622.2	1598.1	1576.2	1553.8	1532.1
94.80			1663.8					
99.75			1680.6	1657.0	1633.6	1611.8	1589.8	1568.0
104.75			1697.2					
109.70			1713.6	1690.2	1666.9	1645.6	1623.8	1602.8
114.70			1729.5					
119.70			1744.9	1722.1	1699.1	1677.9	1656.9	1637.0
124.65			1760.5					
129.65			1775.0	1752.1	1730.3	1709.6	1688.9	1669.0
134.60			1790.0					
139.60				1782.3	1760.1	1739.8	1719.9	1699.4
149.55				1810.7	1789.4	1769.1	1748.7	1730.1

complete sets of data measured for each paraffin were fitted with a rational function which correlates $1/c^2$ instead of c:

$$\frac{1}{c^2} = \frac{A + BP + CP^2 + DP^3}{E + FP} \tag{1}$$

where

$$A = A_0 + A_1 T + A_2 T^2 + A_3 T^3 \tag{2}$$

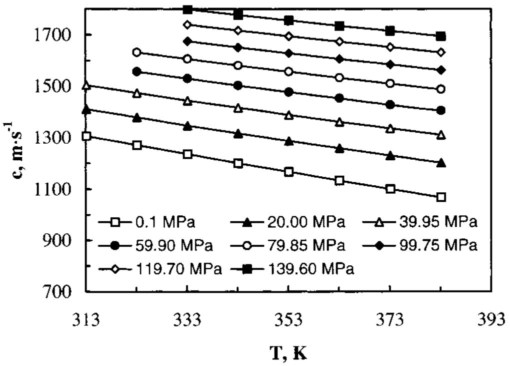

Fig. 1. Speed of sound c in n-octadecane as a function of temperature T.

and

$$E = 1 + E_1 T \tag{3}$$

The two sets of parameters determined by a least-squares method, along with the average deviation (AD%), the average absolute deviation (AAD%), and the maximum deviation MD%, are listed in Table III. Comparisons of the average and average absolute deviations show that the smoothing function does not introduce any systematic error. Moreover, the maximum deviation observed between the experimental and the calculated values shows that this function can be used to interpolate the speed-of-sound data of both components within the experimental accuracy. The

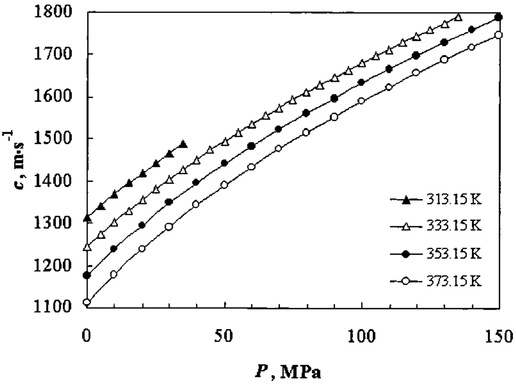

Fig. 2. Speed of sound c in n-nonadecane as a function of pressure P.

Table III. Parameters of Eqs. (1) to (3) with T in K, P in MPa, and c in $\mathrm{m \cdot s^{-1}}$

Parameter			Deviation of c
Octadecane			
$A_0 = 8.62188 \times 10^{-9}$	$A_3 = -3.59050 \times 10^{-16}$	$D = 8.43031 \times 10^{-15}$	$\mathrm{AD\%} = 7.2 \times 10^{-5}$
$A_1 = 1.12448 \times 10^{-9}$	$B = 1.28148 \times 10^{-9}$	$E_1 = -1.68934 \times 10^{-3}$	$\mathrm{AAD\%} = 2.1 \times 10^{-2}$
$A_2 = -7.44890 \times 10^{-13}$	$C = -3.91790 \times 10^{-12}$	$F = 6.43135 \times 10^{-3}$	$\mathrm{MD\%} = 6.9 \times 10^{-2}$
Nonadecane			
$A_0 = 1.52809 \times 10^{-7}$	$A_3 = -4.09450 \times 10^{-15}$	$D = 8.27444 \times 10^{-15}$	$\mathrm{AD\%} = 8.9 \times 10^{-4}$
$A_1 = -1.68690 \times 10^{-10}$	$B = 1.29459 \times 10^{-9}$	$E_1 = -1.66138 \times 10^{-3}$	$\mathrm{AAD\%} = 2.1 \times 10^{-2}$
$A_2 = 3.09637 \times 10^{-12}$	$C = -3.93190 \times 10^{-12}$	$F = 6.48816 \times 10^{-3}$	$\mathrm{MD\%} = 9.0 \times 10^{-2}$

validity of the present measurements was checked by comparison with literature data [8, 9] available only at atmospheric pressure. Comparison with data reported by Wang et al. [8] for octadecane in the full temperature range shows that our experimental data are significantly higher than those of Wang et al., with an average deviation of about 1.5%. On the other hand, our measurements are in good agreement with the data of Plantier et al. [9], with an average absolute deviation of only 0.07 %for octadecane and 0.05 %for nonadecane.

4. DERIVED THERMOPHYSICAL PROPERTIES

The speed-of-sound values measured in octadecane and nonadecane were used to deduce the volumetric behavior of these compounds as a function of pressure using a modification [1, 2] of Davis and Gordon's procedure [10]. The method is based on the relationships which link the isentropic compressibility k_S to the speed of sound c and the isothermal compressibility k_T to k_S:

$$\kappa_S = \frac{1}{\rho c^2} \tag{5}$$

$$\kappa_T = \kappa_S + \frac{T\alpha_p^2}{\rho C_P} \tag{6}$$

which enable, by integrating with pressure, to express density versus pressure in terms of speed of sound:

$$\rho(P, T) = \rho(P_{\text{atmospheric}}, T) + \int_{P_{\text{atmospheric}}}^{P} 1/c^2 \, dP + T \int_{P_{\text{atmospheric}}}^{P} (\alpha_P^2 / C_P) \, dP \tag{7}$$

where α_P represents the isobaric expansion coefficient and C_p the heat capacity at constant pressure. The first term on the right-hand side of Eq. (7) is directly deduced from additional density measurements performed with an Anton Paar, DMA 60 densimeter at atmospheric pressure between 313.15 and 383.15 K in 10 K steps and smoothed as a function of temperature using the following polynomial functions:

$$\rho_0(C_{18}) = 1.0759\times10^3 - 1.5463T + 2.6355\times10^{-3}T^2 - 2.6608\times10^{-6}T^3 \tag{8}$$

$$\rho_0(C_{19}) = 1.0239\times10^3 - 1.0921T + 1.3931\times10^{-3}T^2 - 1.5151\times10^{-6}T^3 \tag{9}$$

with T in K and ρ in $\mathrm{kg\cdot m^{-3}}$ The second term of Eq. (7), which represents the main contribution to the change of density with pressure, is evaluated by analytical integration of Eq. (1). The last term, which can be regarded as an adiabatic perturbation of the second one, is computed iteratively using a predictor-corrector procedure presented in detail in previous papers [1, 2]. The isobaric expansion coefficient, present in the last integral, is determined at each pressure step by differentiation of density with respect to temperature, whereas the heat capacity is found at each stage of the calculation from:

$$C_p(p, T) = C_p(p_0, T) - \int_{p_0}^{p} T[\alpha_P^2 + (\partial\alpha_P/\partial T)_p]/\rho\, dp \tag{10}$$

where the values $(\mathrm{J\cdot K^{-1}\cdot kg^{-1}})$ at atmospheric pressure come from the following functions:

$$C_{p_{C_{18}}} = 1.8867\times10^3 - 4.1170\times10^{-1}T + 5.1\times10^{-3}\,T^2 \tag{11}$$

$$C_{p_{C_{19}}} = 1.1871\times10^3 + 3.3728T \tag{12}$$

which are derived from the recommended values of Zabransky et al. [10].

The results of this numerical analysis are summarized for both paraffins studied in Table IV. These data were fitted to a six-parameter modified Tait equation:

$$\frac{1}{\rho} - \frac{1}{\rho_0} = A\ln\left(\left[\frac{P+B}{P_0+B}\right]\right) \tag{13}$$

$$A = A_0 + A_1T + A_2T^2 \tag{14}$$

$$B = B_0 + B_1T + B_2T^2 \tag{15}$$

Table IV. Density ρ ($\mathrm{kg \cdot m^{-3}}$) Deduced from Ultrasonic Measurements

	T (K)							
P (MPa)	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
Octadecane								
0.1013	768.38	761.61	754.85	748.08	741.29	734.47	727.59	720.65
10.00	774.97	768.52	762.12	755.73	749.34	742.95	736.54	730.10
20.00	781.09	774.92	768.81	762.73	756.67	750.63	744.59	738.55
30.00	786.77	780.84	774.98	769.15	763.37	757.62	751.88	746.15
39.95	792.07	786.34	780.68	775.08	769.53	764.01	758.52	753.05
49.95	797.09	791.54	786.06	780.65	775.29	769.98	764.70	759.46
59.90		796.42	791.10	785.85	780.66	775.53	770.44	765.38
69.90		801.07	795.89	790.79	785.76	780.78	775.85	770.96
79.85		805.47	800.43	795.46	790.55	785.71	780.92	776.18
89.80		809.68	804.75	799.90	795.12	790.40	785.74	781.12
99.75			808.89	804.14	799.47	794.87	790.32	785.82
109.70			812.86	808.21	803.64	799.13	794.69	790.30
119.70			816.69	812.13	807.65	803.24	798.90	794.60
129.65			820.37	815.90	811.50	807.17	802.91	798.71
139.60			823.92	819.52	815.21	810.96	806.78	802.65
149.55				823.03	818.79	814.61	810.51	806.46
Nonadecane								
0.1013	772.02	765.37	758.69	752.00	745.27	738.49	731.67	724.78
10.00	778.49	772.16	765.84	759.51	753.18	746.82	740.45	734.04
20.00	784.51	778.46	772.43	766.41	760.39	754.38	748.37	742.34
30.00	790.11	784.29	778.51	772.74	767.00	761.27	755.55	749.83
39.95		789.71	784.14	778.60	773.08	767.59	762.11	756.64
49.95		794.84	789.45	784.09	778.78	773.49	768.22	762.97
59.90		799.65	794.42	789.24	784.09	778.98	773.90	768.83
69.90		804.24	799.16	794.13	789.14	784.18	779.25	774.36
79.85		808.60	803.64	798.74	793.89	789.07	784.29	779.54
89.80			807.92	803.14	798.41	793.72	789.07	784.44
99.75			812.01	807.34	802.72	798.15	793.61	789.11
109.70			815.94	811.37	806.85	802.38	797.95	793.55
119.70			819.74	815.26	810.84	806.46	802.13	797.83
129.65			823.38	818.99	814.65	810.36	806.12	801.91
139.60				822.58	818.33	814.12	809.96	805.83
149.55				826.06	821.88	817.75	813.66	809.61

which reproduces density values (Table V) with a deviation less than the uncertainty of the procedure which has been estimated, on the basis of comparisons with literature [7] data, at 0.1%. The knowledge of c and ρ under the same conditions makes it possible to plot a set of curves $c(\rho)$ along isobars and isotherms (Fig. 3), the respective shapes of which are

Table V. Parameters of the Tait equation [Eqs. (13)–(15)] with T in K, P in MPa, and ρ in $kg \cdot m^{-3}$

Parameter			Deviation
Octadecane			
$A_0 = -7.54430 \times 10^{-5}$	$A_2 = 4.87140 \times 10^{-11}$	$B_1 = -1.10982$	AD% = 0.17
$A_1 = -1.36010 \times 10^{-7}$	$B_0 = 3.58689 \times 10^{2}$	$B_2 = 8.76030 \times 10^{-4}$	AAD% = 0.52
Nonadecane			
$A_0 = -5.14650 \times 10^{-5}$	$A_2 = 1.69545 \times 10^{-10}$	$B_1 = -1.03098$	AD% = 0.17
$A_1 = -2.43900 \times 10^{-7}$	$B_0 = 3.43616 \times 10^{2}$	$B_2 = 7.86224 \times 10^{-4}$	AAD% = 0.49

regular and almost-linear. Moreover, the procedure leads, using Eqs. (5) and (6), to the evaluation of the isentropic and isothermal compressibilities at different pressures and temperatures of the investigation. These are given in Tables VI and VII. The isothermal compressibility was also derived from the fitted Tait equations in order to check the validity of the procedure which involves first- and second-order derivatives. The comparison reveals excellent agreement between the two sets of compressibility data, those resulting from Eq. (5), on the one hand, and those resulting from the derivative of the Tait equation, on the other hand. The two data sets deviate by 0.2% on average with an average absolute deviation of 0.5% for octadecane and nonadecane.

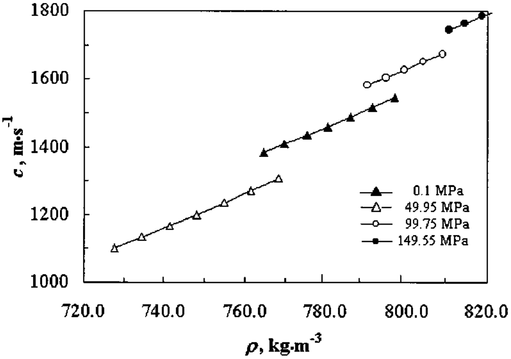

Fig. 3. Speed of sound c in n-octadecane as a function of density ρ.

Table VI. Isentropic Compressibility κ_S (GPa^{-1}) Deduced from Ultrasonic Measurements

	T (K)							
P (MPa)	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
Octadecane								
0.1013	0.7631	0.8142	0.8685	0.9278	0.9919	1.0610	1.1355	1.2188
10.00	0.6975	0.7396	0.7841	0.8316	0.8835	0.9374	0.9955	1.0586
20.00	0.6428	0.6783	0.7169	0.7563	0.7982	0.8423	0.8887	0.9392
30.00	0.5969	0.6283	0.6605	0.6949	0.7304	0.7670	0.8057	0.8469
39.95	0.5587	0.5857	0.6139	0.6434	0.6740	0.7056	0.7393	0.7736
49.95	0.5256	0.5494	0.5746	0.6004	0.6270	0.6553	0.6831	0.7128
59.90		0.5184	0.5407	0.5636	0.5873	0.6108	0.6367	0.6626
69.90		0.4908	0.5110	0.5315	0.5528	0.5741	0.5965	0.6200
79.85		0.4664	0.4846	0.5036	0.5223	0.5419	0.5619	0.5824
89.80		0.4447	0.4614	0.4787	0.4957	0.5135	0.5315	0.5501
99.75			0.4406	0.4565	0.4720	0.4881	0.5043	0.5214
109.70			0.4218	0.4363	0.4508	0.4654	0.4805	0.4959
119.70			0.4048	0.4183	0.4315	0.4451	0.4590	0.4733
129.65			0.3892	0.4014	0.4140	0.4266	0.4396	0.4527
139.60			0.3750	0.3868	0.3979	0.4098	0.4219	0.4340
149.55				0.3732	0.3837	0.3946	0.4057	0.4172
Nonadecane								
0.1013	0.7495	0.7981	0.8515	0.9084	0.9700	1.0363	1.1082	1.1833
10.00	0.6847	0.7267	0.7701	0.8159	0.8655	0.9183	0.9737	1.0337
20.00	0.6323	0.6675	0.7037	0.7428	0.7835	0.8264	0.8719	0.9202
30.00	0.5883	0.6188	0.6502	0.6832	0.7171	0.7540	0.7923	0.8324
39.95		0.5773	0.6052	0.6339	0.6635	0.6945	0.7269	0.7601
49.95		0.5423	0.5666	0.5919	0.6178	0.6449	0.6724	0.7021
59.90		0.5118	0.5336	0.5561	0.5790	0.6027	0.6274	0.6532
69.90		0.4849	0.5046	0.5250	0.5458	0.5667	0.5883	0.6114
79.85		0.4612	0.4790	0.4978	0.5160	0.5352	0.5547	0.5748
89.80			0.4561	0.4732	0.4904	0.5071	0.5249	0.5431
99.75			0.4360	0.4511	0.4668	0.4823	0.4985	0.5155
109.70			0.4174	0.4314	0.4461	0.4603	0.4753	0.4905
119.70			0.4007	0.4136	0.4272	0.4404	0.4541	0.4678
129.65			0.3855	0.3977	0.4100	0.4222	0.4349	0.4477
139.60				0.3827	0.3944	0.4058	0.4174	0.4297
149.55				0.3692	0.3800	0.3907	0.4019	0.4126

Table VII. Isothermal Compressibility κ_T (GPa^{-1}) Deduced from Ultrasonic Measurements

	T (K)							
P (MPa)	313.15	323.15	333.15	343.15	353.15	363.15	373.15	383.15
Octadecane								
0.1013	0.9038	0.9607	1.0214	1.0882	1.1607	1.2394	1.3247	1.4205
10.00	0.8222	0.8683	0.9174	0.9702	1.0279	1.0885	1.1539	1.2253
20.00	0.7547	0.7931	0.8350	0.8782	0.9244	0.9732	1.0248	1.0811
30.00	0.6985	0.7320	0.7667	0.8038	0.8424	0.8825	0.9251	0.9705
39.95	0.6518	0.6803	0.7104	0.7418	0.7748	0.8090	0.8456	0.8830
49.95	0.6116	0.6365	0.6630	0.6903	0.7186	0.7489	0.7788	0.8110
59.90		0.5990	0.6223	0.6463	0.6713	0.6963	0.7239	0.7517
69.90		0.5659	0.5868	0.6081	0.6303	0.6529	0.6766	0.7015
79.85		0.5368	0.5554	0.5749	0.5944	0.6149	0.6359	0.6576
89.80		0.5109	0.5279	0.5455	0.5630	0.5815	0.6003	0.6198
99.75			0.5032	0.5193	0.5352	0.5517	0.5686	0.5864
109.70			0.4810	0.4956	0.5103	0.5252	0.5409	0.5568
119.70			0.4609	0.4744	0.4877	0.5016	0.5158	0.5305
129.65			0.4426	0.4547	0.4674	0.4801	0.4933	0.5067
139.60			0.4259	0.4375	0.4486	0.4606	0.4728	0.4852
149.55				0.4216	0.4321	0.4429	0.4541	0.4658
Nonadecane								
0.1013	0.8838	0.9387	0.9989	1.0634	1.1334	1.2090	1.2911	1.3776
10.00	0.8037	0.8503	0.8988	0.9502	1.0059	1.0652	1.1278	1.1957
20.00	0.7391	0.7778	0.8178	0.8611	0.9063	0.9542	1.0049	1.0589
30.00	0.6852	0.7184	0.7528	0.7890	0.8263	0.8669	0.9093	0.9537
39.95		0.6681	0.6984	0.7295	0.7619	0.7958	0.8314	0.8679
49.95		0.6258	0.6519	0.6791	0.7073	0.7367	0.7668	0.7992
59.90		0.5890	0.6123	0.6364	0.6610	0.6866	0.7134	0.7414
69.90		0.5568	0.5776	0.5993	0.6215	0.6440	0.6673	0.6923
79.85		0.5284	0.5471	0.5669	0.5863	0.6069	0.6278	0.6494
89.80			0.5199	0.5379	0.5561	0.5739	0.5929	0.6124
99.75			0.4961	0.5119	0.5284	0.5448	0.5620	0.5801
109.70			0.4741	0.4887	0.5040	0.5190	0.5349	0.5511
119.70			0.4544	0.4677	0.4819	0.4958	0.5102	0.5248
129.65			0.4365	0.4491	0.4618	0.4746	0.4879	0.5015
139.60				0.4315	0.4436	0.4555	0.4676	0.4806
149.55				0.4157	0.4268	0.4380	0.4496	0.4610

5. CONCLUSION

The set of values presented here (experimental data or derived values) represents an original contribution to the chemical compounds under consideration in this study. This information, which will be supplemented soon by data related to heavier compounds of the homologous series and other hydrocarbon species, could be used to check the relevance of correlation functions or thermodynamic models with respect to substances with many carbon atoms. These data will also be useful for the development of models based on group contribution methods.

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