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Thermal Conductivity and Thermal Diffusivity of Xylene Isomers in the Temperature Range 308–360 K at Pressures up to 0.38 GPa

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New, absolute measurements of the thermal conductivity of the three xylene isomers within the temperature range 308–360 K for pressures up to 0.38 GPa are reported. In addition, for two of the isomers, *m*-xylene and *p*-xylene, it has been possible to measure the thermal diffusivity simultaneously within the same range of conditions. The accuracy of the thermal conductivity data reported is one of ±0.3%, whereas for the thermal diffusivity the estimated accuracy is ±6%. It is found that the density dependence of the thermal conductivity for all of the xylenes can be well represented by one equation based on a rigid-sphere model in the same way that has proved successful for normal alkanes. The thermal diffusivity data have been employed to derive heat capacities for the xylenes over a range of pressures.

KEY WORDS: heat capacity; high pressure; *m*-xylene; *o*-xylene; *p*-xylene; thermal conductivity; thermal diffusivity.

1. INTRODUCTION

This paper reports a continuation of the investigation of the thermal conductivity of simple organic liquids over a range of pressures by means of the transient hot-wire technique [1–3]. Results are presented for the three isomers of xylene: *o*-xylene, *m*-xylene, and *p*-xylene. The motivation for this study of aromatic systems is, in part, to establish a reliable interpolation and prediction scheme for their thermal conductivity similar to that which has proved successful for alkanes [4]. In addition, the study is conducted to investigate the variation of the thermal conductivity among isomers of aromatic compounds parallel to that conducted for alkanes [5, 6].

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With the aid of a reappraisal of the theory of the transient hot-wire technique [7] and small changes in the experimental procedures [8], it has also been possible to determine the thermal diffusivity of *m*-xylene and *p*-xylene over a range of pressures. Whereas the accuracy of the determinations is modest ($\pm 6\%$) [7], it is possible to derive from them values of the heat capacity of the two liquids that have not previously been reported over a range of pressures.

2. EXPERIMENTAL

The thermal conductivity and thermal diffusivity measurements have been performed in the transient hot-wire instrument described elsewhere [9], using the modified computer-controlled system described in Ref. 10. For the present measurements, the thermal conductivity cells remained unchanged apart from the replacement of the platinum sensing elements [9]. However, small changes were made to the manner in which the computer-controlled bridge was operated, in order to secure the highest precision in the measurement of the thermal diffusivity.

The changes were guided by a review of the theory of the transient hot-wire technique as applied to thermal diffusivity measurements [7]. That review indicated that the largest single source of error in the thermal diffusivity measurements arose from the determination of the absolute resistance of the platinum wires at the equilibrium temperature of a measurement prior to a run. Consequently, extreme care was taken in the performance of that measurement in the manner described in detail elsewhere [8]. The precision of the thermal conductivity measurements is left unaltered by this change of procedure, but that of the thermal diffusivity determinations is improved by a factor of two.

The accuracy of the absolute thermal diffusivity measurements, but not the thermal conductivity measurements, is further limited by the uncertainty in the determination of the radius of the 7-μm platinum sensing elements [7, 8]. Consequently, we have evaluated the thermal diffusivity of *m*-xylene and *p*-xylene by the relative method described in Ref. 7. For this purpose we have employed as a reference value the thermal diffusivity κ_{ref}, of toluene at a temperature of 328.5 K and atmospheric pressure [7]

$$\kappa_{\text{ref}} = 8.01 \times 10^{-8}\ \text{m}^2 \cdot \text{s}^{-1} \tag{1}$$

The adoption of toluene as the reference fluid means that fresh measurements of the thermal conductivity and thermal diffusivity under the reference conditions have been necessary. The opportunity has been taken to repeat the measurements of the thermal conductivity of toluene over a wider range of conditions, to check the continued proper operation of our instrument by comparison with our earlier results [2]. It should be emphasized that whereas the thermal diffusivity is evaluated on a relative basis, the measurements of the thermal conductivity of all the liquids studied remain absolute.

The samples of *m*-xylene, *o*-xylene, *p*-xylene, and toluene were all supplied by Aldrich Chemical Co., Gillingham, U.K., and, after distillation and degasification, had a confirmed purity in excess of 99.9%. The measurements on toluene were carried out along four isotherms, 308, 317.6, 330, and 347 K, at pressures up to 50 MPa. For the xylenes, isotherms at 308, 318, 337.6, and 360 K were studied up to a maximum pressure of 380 MPa or the solidification pressure.

For each measurement, appropriate tests were performed to ensure that the results are free from radiative and convective contributions as described earlier [2, 9]. For the application of small corrections in the data reduction we have employed the density data given by Kashiwagi et al. [11] for toluene and by Mamedov et al. [12] for the xylenes. For the xylenes, the highest pressure for which the density has been measured is 50 MPa. Consequently, solely for the purpose of making these corrections, it has been necessary to extrapolate the equation of state fitted to these data for the higher pressures. The effect of this extrapolation on the reported thermal conductivity data is negligible.

3. RESULTS

The thermal conductivity data, corrected to nominal temperatures as described earlier [9], are listed in Tables I to IV. The correction of the thermal conductivity to the nominal temperature never amounted to more than ±0.3% so that the additional uncertainty in the reported data is negligible. It is estimated that the overall error in the tabulated thermal conductivity is one of ±0.3%. The corresponding density is also quoted whenever it lies within the range of direct measurements [12]. No extrapolated density data have been quoted. In addition, the thermal diffusivity is tabulated as the ratio of the measured value to the reference value κ_{ref} of Eq. (1). From it, with the aid of the tabulated density and thermal conductivity, we have derived the isobaric heat capacity C_{p} by means of the definition

$$\kappa = \lambda/\rho C_{\text{p}} \tag{2}$$

The thermal diffusivity determined by the transient hot-wire technique refers to the density and temperature of the fluid under the equilibrium

Table I. Thermal Conductivity, Thermal Diffusivity, and Isobaric Heat Capacity of Toluene

P (MPa)	$\lambda(T_{\text{nom}}, P)$ $(\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1})$	$\kappa/\kappa_{\text{ref}}$	C_p $(\text{kJ} \cdot \text{kg}^{-1} \cdot \text{K}^{-1})$
	$T_{\text{nom}} = 308.15$ K		$T_0 = 305.80$ K
0.1	0.1280	0.967	1936
0.1	0.1278	0.891	2098
0.1	0.1279	0.925	2022
6.8	0.1302	0.970	1952
11.9	0.1321	0.946	2022
20.3	0.1351	0.991	1959
33.5	0.1393	1.027	1930
51.2	0.1445	1.079	1884
51.2	0.1441	1.034	1961
	$T_{\text{nom}} = 317.65$ K		$T_0 = 315.75$ K
0.1	0.1254	0.991	1869
3.0	0.1264	1.030	1807
13.0	0.1303	1.090	1745
23.7	0.1339	1.068	1813
38.7	0.1387	1.050	1887
	$T_{\text{nom}} = 330.65$ K		$T_0 = 328.50$ K
0.1	0.1215	1.000	1821
3.9	0.1231	0.994	1847
12.8	0.1268	1.030	1818
13.3	0.1269	0.870	2154
23.5	0.1308	0.940	2036
36.1	0.1350	1.034	1892
37.4	0.1354	1.034	1895
	$T_{\text{nom}} = 347.15$ K		$T_0 = 345.00$ K
0.1	0.1169	0.969	1848
4.1	0.1187	0.955	1891
12.0	0.1225	0.941	1961
22.9	0.1264	0.987	1908
37.1	0.1311	1.042	1848
51.2	0.1362	0.982	2015
67.5	0.1406	1.023	1974

Table II. Thermal Conductivity, Thermal Diffusivity, and Isobaric Heat Capacity of *m*-Xylene

P (MPa)	ρ_r $(kg \cdot m^{-3})$	$\lambda(T_{nom}, \rho)$ $(W \cdot m^{-1} \cdot K^{-1})$	$\lambda(T_{nom}, P)$ $(W \cdot m^{-1} \cdot K^{-1})$	κ/κ_{ref}	C_p $(kJ \cdot kg^{-1} \cdot K^{-1})$
	$T_{nom} = 308.15$ K			$T_0 = 305.55$ K	
3.4	854.8	0.1288	0.1288	1.016	1857
13.3	862.2	0.1324	0.1323	0.974	1972
25.6	870.6	0.1362	0.1361	1.077	1817
40.2	879.8	0.1401	0.1401	0.994	2004
44.0			0.1408	0.943	
56.6			0.1446	1.107	
75.4			0.1495	1.007	
95.1			0.1538	1.003	
96.4			0.1546	1.096	
122.6			0.1603	1.031	
147.3			0.1653	1.223	
172.5			0.1699	1.198	
173.0			0.1701	1.294	
203.9			0.1755	1.314	
233.1			0.1803	1.305	
238.0			0.1810	1.155	
264.6			0.1853	1.354	
294.5			0.1892	1.285	
294.5			0.1892	1.175	
321.9			0.1931	1.368	
322.0			0.1930	1.012	
323.3			0.1934	1.293	
354.2			0.1973	1.272	
354.4			0.1971	1.320	
381.9			0.2007	1.390	
381.9			0.2004	1.352	
	$T_{nom} = 318.15$ K			$T_0 = 315.65$ K	
3.9	847.0	0.1259	0.1261	0.937	1988
3.9	847.3	0.1261	0.1261	0.929	2006
15.0	855.8	0.1297	0.1297	0.971	1954
23.9	862.2	0.1328	0.1328	0.967	1993
39.5	872.4	0.1377	0.1376	0.951	2076
57.9			0.1428	1.041	
57.9			0.1427	0.988	
76.2			0.1474	1.113	
76.2			0.1476	1.087	
96.9			0.1526	1.088	
119.2			0.1575	1.130	
123.5			0.1588	1.174	
147.3			0.1636	1.150	
172.6			0.1684	1.216	
202.9			0.1741	1.218	
233.9			0.1793	1.281	
264.2			0.1840	1.227	
265.5			0.1842	1.219	
292.1			0.1885	1.300	
323.3			0.1927	1.341	
323.9			0.1929	1.296	
355.5			0.1972	1.336	
383.0			0.2004	1.404	

Table II. *(Continued)*

P (MPa)	ρ_r $(\mathrm{kg \cdot m^{-3}})$	$\lambda(T_{nom}, \rho)$ $(\mathrm{W \cdot m^{-1} \cdot K^{-1}})$	$\lambda(T_{nom}, P)$ $(\mathrm{W \cdot m^{-1} \cdot K^{-1}})$	κ/κ_{ref}	C_p $(\mathrm{kJ \cdot kg^{-1} \cdot K^{-1}})$
	$T_{nom} = 337.65$ K			$T_{nom} = 360.15$ K	
4.4	831.9	0.1210	0.1212	0.874	2088
4.6	832.3	0.1211	0.1211	0.897	2031
14.7	840.8	0.1247	0.1248	0.979	1897
26.5	849.9	0.1289	0.1290	1.020	1861
40.4	859.6	0.1333	0.1333	1.030	1883
55.4			0.1377	1.021	
76.5			0.1440	1.008	
96.3			0.1489	1.070	
122.8			0.1554	1.098	
146.5			0.1604	1.146	
173.7			0.1662	1.207	
202.6			0.1718	1.261	
206.7			0.1721	1.150	
206.8			0.1717	1.176	
233.1			0.1771	1.184	
265.3			0.1826	1.252	
295.9			0.1873	1.250	
323.7			0.1914	1.314	
326.5			0.1916	1.288	
353.4			0.1955	1.298	
382.5			0.1995	1.331	
414.2			0.2038	1.291	
	$T_{nom} = 360.15$ K			$T_{nom} = 357.85$ K	
3.2	812.0	0.1149	0.1150	0.908	1953
3.2	812.3	0.1150	0.1150	0.902	1966
3.1	812.2	0.1152	0.1151	0.878	2023
3.2	812.3	0.1151	0.1151	0.914	1943
3.3	812.2	0.1150	0.1150	0.875	2027
14.9	823.4	0.1194	0.1194	0.909	1997
24.4	831.6	0.1228	0.1228	0.920	2010
24.4	831.6	0.1228	0.1228	0.949	1948
24.4	831.8	0.1228	0.1227	0.922	2004
39.6	843.5	0.1283	0.1283	0.945	2014
56.2			0.1334	1.047	
56.3			0.1334	1.328	
76.9			0.1393	1.030	
97.2			0.1449	1.029	
123.4			0.1515	1.115	
147.2			0.1572	1.140	
173.6			0.1630	1.185	
203.6			0.1690	1.167	
231.6			0.1738	1.220	
264.0			0.1798	1.130	
264.0			0.1798	1.138	
264.0			0.1797	1.160	
294.1			0.1850	1.271	
294.2			0.1850	1.141	
324.1			0.1896	1.287	
354.2			0.1940	1.215	
378.5			0.1975	1.310	

Table III. Thermal Conductivity of *o*-Xylene

P (MPa)	ρ_r ($kg \cdot m^{-3}$)	$\lambda(T_{nom}, \rho_r)$ ($W \cdot m^{-1} \cdot K^{-1}$)	$\lambda(T_{nom}, P)$ ($W \cdot m^{-1} \cdot K^{-1}$)
		$T_{nom} = 308.15$ K	
0.3	869.5	0.1309	0.1307
8.9	875.7	0.1338	0.1336
24.1	885.6	0.1383	0.1381
43.3	897.0	0.1436	0.1434
58.3		0.1471	
76.6		0.1517	
93.4		0.1558	
122.9		0.1610	
143.5		0.1651	
147.8		0.1655	
169.2		0.1699	
194.3		0.1740	
224.7		0.1786	
244.2		0.1816	
		$T_{nom} = 318.15$ K	
2.7	863.2	0.1282	0.1282
16.0	872.7	0.1320	0.1320
26.0	879.7	0.1356	0.1356
41.3	889.1	0.1396	0.1396
57.1		0.1437	
77.0		0.1488	
96.9		0.1536	
122.2		0.1589	
148.2		0.1642	
150.2		0.1645	
173.7		0.1688	
204.0		0.1742	
228.8		0.1781	
228.8		0.1779	
253.3		0.1817	
253.3		0.1818	
279.7		0.1853	

Table III. *(Continued)*

P (MPa)	ρ_r ($kg \cdot m^{-3}$)	$\lambda(T_{nom}, \rho_r)$ ($W \cdot m^{-1} \cdot K^{-1}$)	$\lambda(T_{nom}, P)$ ($W \cdot m^{-1} \cdot K^{-1}$)
$T_{nom} = 337.65$ K			
8.7	850.8	0.1254	0.1255
8.7	850.8	0.1253	0.1254
24.9	863.4	0.1308	0.1308
30.5	867.4	0.1322	0.1322
41.2	874.7	0.1358	0.1358
41.2	874.7	0.1357	0.1357
57.5		0.1403	
77.2		0.1455	
98.6		0.1508	
123.7		0.1563	
148.9		0.1616	
173.8		0.1661	
184.2		0.1677	
204.8		0.1715	
234.9		0.1769	
263.7		0.1818	
263.7		0.1819	
295.1		0.1861	
306.5		0.1875	
319.7		0.1896	
353.0		0.1943	
$T_{nom} = 360.15$ K			
6.0	828.0	0.1183	0.1184
16.1	837.2	0.1120	0.1221
24.0	843.9	0.1249	0.1250
42.4	857.9	0.1308	0.1309
42.4	857.9	0.1307	0.1308
56.8		0.1351	
74.8		0.1403	
97.4		0.1462	
123.1		0.1523	
150.7		0.1580	
171.3		0.1622	
176.3		0.1630	
203.9		0.1684	
233.7		0.1738	
262.6		0.1786	
291.6		0.1833	
325.8		0.1884	
338.0		0.1899	
354.8		0.1921	
382.7		0.1960	
419.2		0.2006	

Table IV. Thermal Conductivity, Thermal Diffusivity, and Isobaric Heat Capacity of *p*-Xylene

P (MPa)	ρ_r $(kg \cdot m^{-3})$	$\lambda(T_{nom}, \rho_r)$ $(W \cdot m^{-1} \cdot K^{-1})$	$\lambda(T_{nom}, P)$ $(W \cdot m^{-1} \cdot K^{-1})$	κ/κ_{ref}	C_p $(kJ \cdot kg^{-1} \cdot K^{-1})$
	$T_{nom} = 308.15$ K			$T_0 = 305.55$ K	
4.4	850.8	0.1257	0.1257	1.000	1851
8.8	854.2	0.1273	0.1273	0.972	1920
15.9	859.5	0.1296	0.1296	1.039	1817
22.4	864.1	0.1319	0.1319	1.075	1776
41.0	876.2	0.1373	0.1373	1.031	1900
53.8			0.1407	1.115	1784
	$T_{nom} = 318.15$ K			$T_0 = 315.55$ K	
3.9	842.5	0.1232	0.1231	0.918	1992
4.0	842.6	0.1231	0.1231	0.923	1982
4.1	842.7	0.1232	0.1232	0.920	1990
14.6	851.2	0.1270	0.1269	0.930	2006
14.7	851.2	0.1268	0.1268	0.959	1944
24.2	858.2	0.1300	0.1299	0.954	1986
39.2	868.5	0.1347	0.1345	0.983	1973
57.8			0.1397	1.020	
78.7			0.1453	1.032	
	$T_{nom} = 337.65$ K		$T_0 = 335.25$ K		
5.4	827.3	0.1185	0.1185	0.848	2113
15.1	835.9	0.1219	0.1219	0.882	2069
15.1	835.9	0.1218	0.1218	0.883	2066
24.3	843.4	0.1249	0.1248	0.904	2049
39.0	854.3	0.1300	0.1299	0.941	2022
39.0	854.3	0.1300	0.1300	0.945	2013
55.1			0.1347	0.992	
55.5			0.1348	0.991	
55.5			0.1349	1.000	
76.6			0.1405	0.980	
96.4			0.1456	1.002	
121.3			0.1521	1.094	
147.4			0.1576	1.044	
	$T_{nom} = 360.15$ K			$T_0 = 358.25$ K	
3.5	805.2	0.1122	0.1123	0.867	2013
3.6	805.3	0.1122	0.1124	0.844	2068
14.5	816.5	0.1163	0.1165	0.857	2080
15.5	817.4	0.1169	0.1170	0.895	2000
24.2	825.4	0.1197	0.1199	0.920	1973
40.6	838.7	0.1253	0.1255	0.994	1881
40.0	838.3	0.1253	0.1254	0.953	1962
40.0	838.4	0.1255	0.1256	0.919	2039
55.3			0.1304	0.977	
76.5			0.1366	1.008	
97.0			0.1421	1.061	
118.1			0.1473	1.049	
124.6			0.1491	1.113	
148.6			0.1547	1.077	
173.3			0.1600	1.148	
197.8			0.1650	1.146	

conditions prior to a run (T_0, P). Thus, in order to evaluate the heat capacity under these conditions, the thermal conductivity is corrected to that state and the density evaluated from the available equations of state [11, 12]. This process introduces only a very small additional error into the reported heat capacity for the state (T_0, P). It is estimated that the overall error in the thermal diffusivity ratio and in the heat capacity is one of ±6%.

Figure 1 shows the deviations of the repeated measurements of the thermal conductivity of toluene from the correlation of our earlier measurements [2]. The standard deviation of the data is one of ±0.6%, which is commensurate with the mutual uncertainty of the present data and the correlation. In general, the pressure dependence along an isotherm is rather more consistent between the two sets of data than in the absolute thermal conductivity. This is a reflection of the fact that the precision of the experimental method is superior to the accuracy.

For the purposes of interpolation, the thermal conductivity has been represented as a function of pressure along each isotherm by means of the equation

$$\lambda = \lambda' \left[1 + \sum_{i=1}^{4} a_i \frac{p - p'}{p'} \right] \tag{3}$$

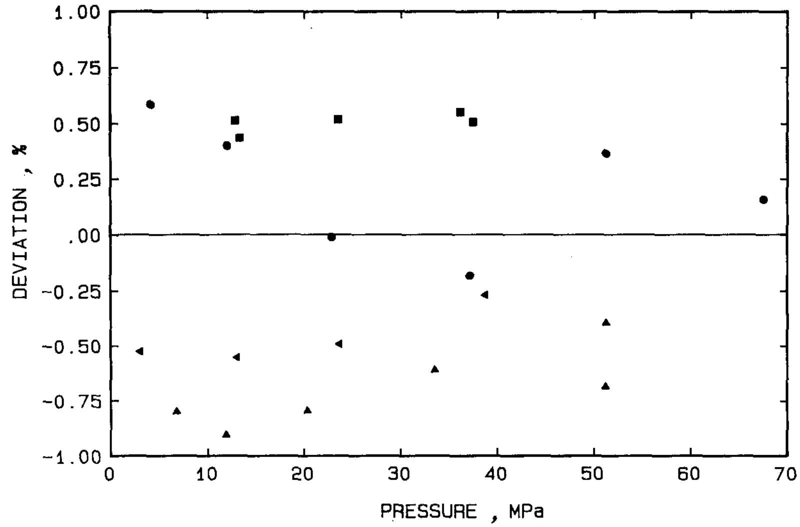

Fig. 1. A comparison of the new measurements of the thermal conductivity of toluene with a correlation of earlier results [2]. (▲) 308.15 K; (◀) 320.15 K; (■) 330.15 K; (●) 345.15 K.

Table V. Coefficients of the Correlation of the Pressure Dependence of the Thermal Conductivity Eq. (3)

T (K)	λ' ($mW \cdot m^{-1} \cdot K^{-1}$)	$10\,a_1$	$10^2\,a_2$	$10^2\,a_3$	$10^2\,a_4$
		o-Xylene; $p' = 250$ MPa			
308.15	182.39	1.9512	−7.7619	−6.1889	−7.2386
318.15	181.22	1.9957	−7.9077	−1.4013	−3.3111
337.65	179.29	2.2372	−4.8354	0.30786	−4.2433
360.15	176.40	2.3554	−4.8825	2.1394	−3.4978
		m-Xylene; $p' = 250$ MPa			
308.15	182.88	2.0726	−5.4278	2.4636	−1.4461
318.15	181.87	2.2039	−4.9685	1.1018	−3.3227
337.65	179.82	2.3116	−5.1852	2.7240	−2.4975
360.15	177.40	2.4847	−5.7717	2.1210	−3.1284
		p-Xylene; $p' = 50$ MPa			
308.15	139.70	0.94453	0.87091	6.0582	3.5757
318.15	137.61	1.0109	−1.0722	0.61962	0.21557
337.65	133.15	1.1081	−1.1622	0.37688	−0.10747
360.15	128.64	1.2242	−1.3211	0.17849	−0.01311

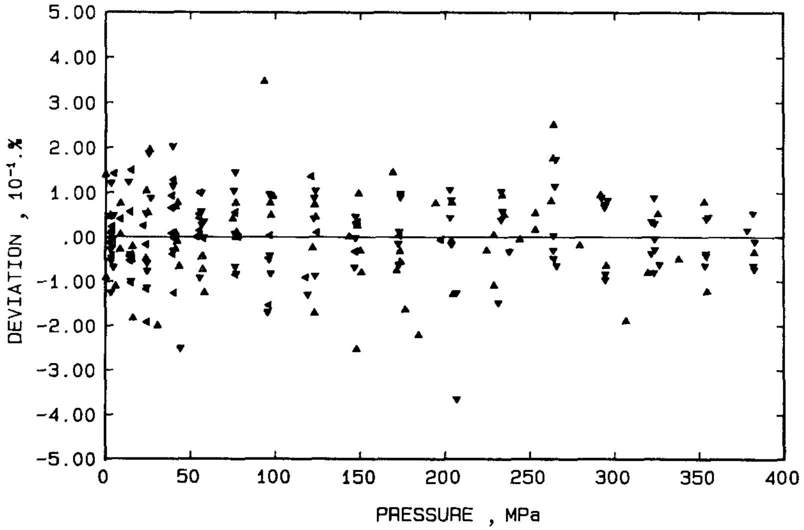

Fig. 2. Deviations of the thermal conductivity of the three isomers of xylene from the correlation of Eq. (3). (▲) *o*-xylene; (▼) *m*-xylene; (◀) *p*-xylene.

The coefficients a_i of this equation are listed in Table V for the three xylene isomers.

The deviations of the experimental data from this correlation are plotted in Fig. 2. Taken over all three isomers the standard deviation of the data from the correlation is about $\pm 0.1\%$, while the maximum deviation is $\pm 0.4\%$.

4. DISCUSSION

4.1. The Density Dependence of the Thermal Conductivity

In the case of normal alkanes [4] it has proved possible to develop a reliable scheme for the representation and prediction of the thermal conductivity based upon the results of a rigid-sphere model of the fluids. The essence of the representation is that the experimental group

$$\lambda^* = 1.936 \times 10^7 \, \lambda V^{2/3} (M/RT)^{1/2} = F(V/V_0) \tag{4}$$

is, for a particular fluid, a function only of the ratio of the molar volume V to a characteristic molar volume V_0, which is itself but weakly temperature dependent. In Eq. (4), M is the molar mass and R is the universal gas constant.

In the case of alkanes it has been found not only is λ^* a function only of V/V_0, but also that it is universal among alkanes from ethane to tridecane [4]. It is therefore worthwhile to examine whether a similar representation of the data for the three isomers of xylene can be achieved.

For this purpose, and guided by the results of the earlier work on alkanes [4, 6], we have represented λ^* by the equation

$$\ln \lambda^* = A + B \ln[V/V_{0_i}(T)] \tag{5}$$

in which A and B are coefficients universal among the three isomers of xylene and V_{0_i} is a species and temperature-dependent characteristic volume. The adoption of a single reference value of V_0 for n-xylene at $T = 308.15$ K,

$$V_{0_{\text{ref}}} = V_0(308.15\ \text{K}) = 79.88 \times 10^{-6}\ \text{m}^3 \cdot \text{mol}^{-1} \tag{6}$$

then allows the experimental thermal conductivity for the three isomers along all isotherms to be employed to determine the optimum values of the coefficients A and B as well as the values of $V_{0_i}(T)$ for other species and temperatures. In this way the optimum correlation has been determined as

$$\ln \lambda^* = 4.675 - 2.234 \ln[V/V_{o_i}(T)] \tag{7}$$

The corresponding values of the ratio $V_{o_i}(T)/V_{0_{\text{ref}}}$ are listed in Table VI.

Table VI. Characteristic Volumes for the xylenes, $V_{0_{\mathrm{ref}}} = 79.88 \times 10^{-6}\ \mathrm{m^3 \cdot mol^{-1}}$

T (K)	$V_0(T)/V_{0_{\mathrm{ref}}}$		
	o-Xylene	*m*-Xylene	*p*-Xylene
308.15	0.9854	1.0	0.9955
318.15	0.9777	0.9949	0.9913
337.65	0.9732	0.9868	0.9838
360.15	0.9676	0.9800	0.9787

Figure 3 displays the deviations of all the experimental thermal conductivity data for the xylenes (within the range of the available density data) from the universal correlation of Eq. (7). It can be seen that the maximum deviation amounts to no more than ±0.4%, while the standard deviation is one of ±0.15%. This result provides ample confirmation of the universality of Eq. (7) among the three xylene isomers and, as usual [4], permits ready and reliable interpolation *and* extrapolation of the present thermal conductivity data to other conditions.

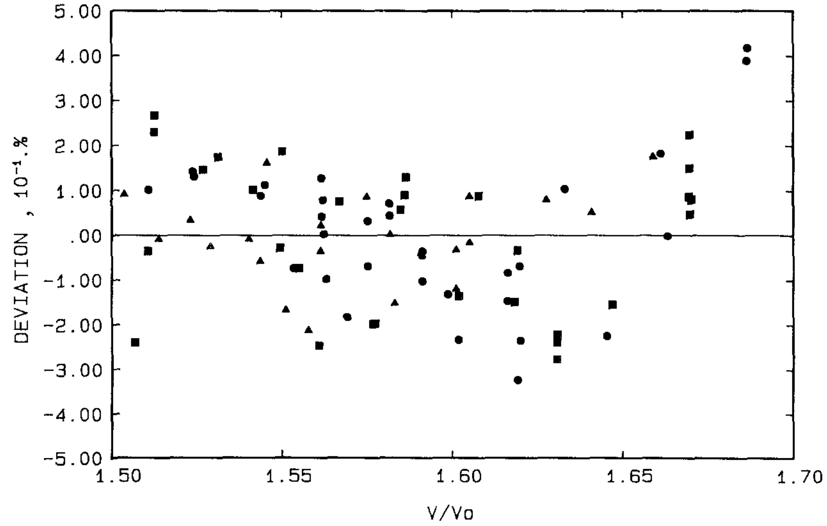

Fig. 3. Deviations of the thermal conductivity of the three isomers of xylene from the correlation of Eq. (7). (▲) *o*-xylene; (■) *m*-xylene; (●) *p*-xylene.

4.2. The Variation of the Thermal Conductivity Among the Isomers

In the case of alkanes, previous investigations [5, 6] have revealed a difference between the thermal conductivity of normal and that of branched isomers of as much as 30% at the same density and temperature. The structural changes among the xylene isomers studied here are obviously considerably less than those encountered in the alkanes. It is therefore of some interest to examine the differences in the thermal conductivity among the xylenes. Use of the correlation of the previous section with the parameters in Table VI immediately shows that the maximum differences between the thermal conductivity of the isomers at the same temperature and density amounts to some 3%. We therefore find that the differences of thermal conductivity reflect the relatively small conformational changes among the isomers of xylene.

4.3. The Isobaric Heat Capacity

The accuracy claimed for the thermal diffusivity and isobaric heat capacities listed in Tables I to IV is modest by comparison with that attainable by a purpose-built apparatus. Nevertheless, the values reported for C_p of the xylenes are the first reported over a range of pressures. Within the estimated accuracy of the data there is no evidence of a pressure dependence of C_p and the three isomers have the same heat capacity.

5. CONCLUSIONS

The thermal conductivity of the three xylene isomers—*m*-xylene, *o*-xylene, and *p*-xylene, has been determined over a range of temperature and pressure. The density dependence of the thermal conductivity of all three isomers has been represented by one equation characterized by a single parameter specific to the isomer. The correlation permits reliable evaluation of the thermal conductivity for thermodynamic states beyond those covered in the present study.

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