Table III. Antoine Constants[a]

material	A	B	C
THF(1)	6.99515	1202.290	226.254
methanol(4)	8.00902	1541.861	236.154
ethanol(4)	8.04610	1555.547	222.830
2-propanol(1)	7.74021	1359.517	197.527
1-propanol(1)	7.74416	1437.686	198.463

[a] $\log P/\text{mmHg} = A - B/[t(°C) + C]$.

Table IV. Wilson Parameters

	system[a]			
Λ	I	II	III	IV
Λ_{12}	0.6661	1.0465	1.4248	1.5245
Λ_{21}	0.6023	0.4758	0.4275	0.4052

[a] System I: THF(1)–methanol(2). System II: THF(1)–ethanol(2). System III: THF(1)–2-propanol(2). System IV: THF(1)–1-propanol(2).

Table V. Vapor–Liquid Equilibria at 760 mmHg Pressure, Evaluated from Wilson Equation[a]

	system I		system II		system III		system IV	
x_1	y_1	t, °C	y_1	t, °C	y_1	t, °C	y_1	t, °C
0.00	0.000	64.5	0.000	78.3	0.000	82.2	0.000	97.2
0.05	0.094	63.2	0.109	76.7	0.098	81.0	0.138	94.6
0.10	0.170	62.3	0.202	75.2	0.186	79.7	0.256	92.2
0.20	0.283	60.9	0.350	72.8	0.339	77.4	0.444	87.7
0.30	0.368	60.2	0.464	70.8	0.466	75.3	0.584	83.8
0.40	0.437	59.8	0.555	69.3	0.572	73.4	0.690	80.2
0.50	0.498	59.6	0.631	68.1	0.661	71.7	0.770	77.1
0.60	0.559	59.8	0.698	67.1	0.737	70.2	0.832	74.4
0.70	0.626	60.2	0.762	66.4	0.805	68.9	0.883	72.0
0.80	0.706	61.1	0.826	65.9	0.868	67.8	0.925	69.8
0.90	0.818	62.8	0.901	65.7	0.931	66.8	0.963	67.9
0.95	0.896	64.1	0.946	65.8	0.964	66.4	0.981	66.9
1.00	1.000	66.0	1.000	66.0	1.000	66.0	1.000	66.0

[a] System I: THF(1)–methanol(2). System II: THF(1)–ethanol(2). System III: THF(1)–2-propanol(2). System IV: THF(1)–1-propanol(2).

–ethanol, –2-propanol, and –1-propanol.

The vapor–liquid equilibrium relations obtained in the present work are listed in Table V and shown in Figure 3. Figure 4 shows the equilibrium relations for the THF–methanol system, in which the previous data (*5*) are those at 600 mmHg pressure. In the THF–2-propanol system, our data agreed fairly well with the previous data (*8*) as shown in Figure 5, with the absolute arithmetic mean difference of 0.0057 mole fraction in vapor composition.

The azeotropic-point determination from only boiling-point measurement seems essentially unreliable, but the azeotropic points evaluated here from the Wilson equation for the THF–methanol and THF–ethanol systems are as follows: for the THF–methanol system, 0.496 mole fraction THF at 59.6 °C [0.497 mole fraction THF at 60.7 °C (*3*)]; for the THF–ethanol system, 0.905 mole fraction THF at 65.7 °C [0.85 mole fraction THF (*3*)]. If one makes a comparison with the previous data (*3*), the agreements of azeotropic composition are excellent for the THF–methanol system, but not so good for THF–ethanol system.

The small ebulliometer shown in the present paper seems powerful for the rapid determination of vapor–liquid equilibria and for experiments with expensive chemicals.

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Glossary

A, *B*, *C*	Antoine constants
m	differential value (d*t*/d*P*)
P	vapor pressure, mmHg
t	temperature, °C
x	mole fraction in liquid phase
y	mole fraction in vapor phase

Greek Notation

γ	activity coefficient
Λ	Wilson parameter
π	total pressure, mmHg

Subscripts

i	component
1	tetrahydrofuran
2	alcohol

Superscript

•	raw data

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Densities of *n*-Hexane–Aromatic Hydrocarbon Mixtures

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Densities of binary mixtures of *n*-hexane with toluene, ethylbenzene, propylbenzene, and butylbenzene were measured at 298.15 and 323.15 K by using a 10-mL pycnometer and are reported in this paper.

Introduction

The purpose of this paper is to report measurements of the densities of binary mixtures of *n*-hexane with several aromatic hydrocarbons. These measurements were made as part of a

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Table I. Densities of Pure Components at 298.15 K

	d(measd), kmol m^{-3}	d(ref 1), kmol m^{-3}
n-hexane	7.606	7.599
toluene	9.356	9.359
ethylbenzene	8.123	8.125
n-propylbenzene	7.138	7.136
n-butylbenzene	6.388	6.378

Table II. Densities of n-Hexane-Toluene Mixtures

concn x_1	d(measd at 298.15 K), kmol m^{-3}	d(measd at 323.15 K), kmol m^{-3}
0.000	9.356	9.103
0.100	9.154	8.901
0.185	9.001	8.748
0.307	8.790	8.533
0.397	8.630	8.375
0.518	8.422	8.161
0.589	8.283	8.023
0.726	8.052	7.790
0.795	7.952	7.688
0.920	7.729	7.462
1.000	7.606	7.329

Table III. Densities of n-Hexane-Ethylbenzene Mixtures

concn x_1	d(measd at 298.15 K), kmol m^{-3}	d(measd at 323.15 K), kmol m^{-3}
0.000	8.123	7.914
0.105	8.084	7.866
0.235	8.004	7.826
0.338	7.975	7.754
0.437	7.923	7.692
0.548	7.850	7.612
0.646	7.797	7.555
0.711	7.765	7.517
0.831	7.700	7.458
0.920	7.650	7.385
1.000	7.606	7.329

continuing project on the thermodynamic and transport properties of hydrocarbon mixtures.

Experimental Section

The experimental method has been reported previously (*3*). The only difference in the present study is that a 10-mL pycnometer was used here instead of a 1-mL pycnometer for greater accuracy. Mixtures were made up by weighing the purest commercially available grade components obtained from BDH Chemicals (with quoted purities of more than 99%). The measured densities of the pure components agreed with literature values (*1*) as shown in Table I, so that further purification was not undertaken. We estimate the precision in the compositions to be ±0.001 and in the density to be ±0.02%.

Results

Experimental results are tabulated in Tables II–V. Figure 1 shows a comparison between the density values measured in this work and those reported by Letcher (*2*) for n-hexane–toluene mixtures at 298.15 K. Agreement between the two sets

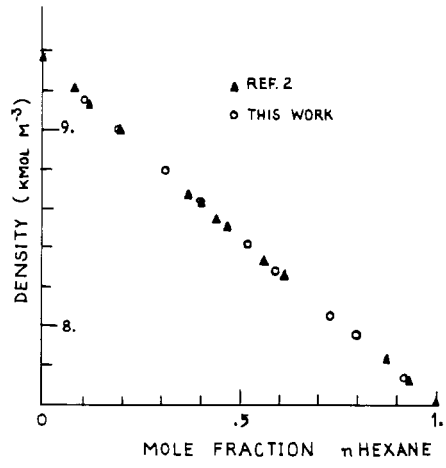

Figure 1. Comparison of measured densities in n-hexane–toluene mixtures with the measurements of Letcher (*2*).

Table IV. Densities of n-Hexane-n-Propylbenzene Mixtures

concn x_1	d(measd at 298.15 K), kmol m^{-3}	d(measd at 323.15 K), kmol m^{-3}
0.000	7.138	6.962
0.100	7.187	7.004
0.197	7.236	7.049
0.293	7.281	7.087
0.395	7.339	7.136
0.522	7.387	7.171
0.599	7.426	7.204
0.699	7.473	7.243
0.798	7.520	7.277
0.898	7.523	7.301
1.000	7.606	7.332

Table V. Densities of n-Hexane-n-Butylbenzene Mixtures

concn x_1	d(measd at 298.15 K), kmol m^{-3}	d(measd at 323.15 K), kmol m^{-3}
0.000	6.388	6.236
0.102	6.500	6.342
0.198	6.609	6.446
0.299	6.728	7.577
0.395	6.844	6.663
0.495	6.969	6.778
0.594	7.079	6.877
0.697	7.211	6.982
0.798	7.342	7.110
0.904	7.476	7.227
1.000	7.606	7.332

of results is excellent. No literature values could be found for any of the other mixtures studied by us.

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