Physical Properties of 16 Selected C_7 and C_8 Alkene Hydrocarbons

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DATA ON THE densities, refractive indices, and boiling points and vapor pressures for 111 different API Research hydrocarbons (*1, 3, 11*) have been reported by the American Petroleum Institute Research Project 6. In this article similar data are reported for 16 selected C_7 and C_8 alkenes. These were made available by the API Research Project 44 at the Carnegie Institute of Technology. The samples, referred to by compound number in the tables, were purified by Research Project 6.

In each case the impurity was of such nature and present in such small amount that the properties measured were not affected beyond the indicated limits of uncertainty. The purification and determination of purity and freezing point of these compounds have been or will be described in other reports (*5-9*).

MEASUREMENTS

The measurements of density were made at 20°, 25°, and 30° C., with a density balance previously described (*4*). The experimental values of density are given in Table I. Individual measurements were reproducible within 0.00003 gram per ml. The accuracy of the tabulated values is estimated to be ±0.00005 to ±0.00010 gram per ml.

The refractive index was measured by the apparatus and procedure described (*3*). The calculations and correlations were similarly made as described, where the data obtained were correlated by the Hartmann equation, modified by Tilton and Gurewitz (*10*):

$$n_\lambda = n_\infty + C/(\lambda - \lambda^*)^{1.6}$$

Table II gives the values of the constants of the modified Cauchy equation. Table III gives the values of the constants of the modified Hartmann equation. The last columns of Tables II and III gives the root mean square values of the deviations of the observed from the calculated points. Individual measurements were reproducible within ±0.00002 to ±0.00003. The accuracy of the tabulated values is estimated to be ±0.00005 to ±0.00008. Table IV gives refractive index values at 7 wave lengths at 20°, 25°, and 30° C.

(text continued on page 372)

Table I. Values of Density and Per Cent Purity of Compounds Studied

No.	Compound	Formula	Density[a], G./Ml. 20° C.	25° C.	30° C.	Temp. Coeff. of Density at 25° C., G./Ml. ° C.	Purity, Mole %
1	3-Methyl-*cis*-3-hexene	C_7H_{14}	0.71287	0.70795	0.70413	0.000874	99.85 ± 0.10
2	3-Methyl-*trans*-3-hexene	C_7H_{14}	0.70965	0.70506	0.70094	0.000871	99.85 ± 0.10
3	2,4-Dimethyl-1-pentene	C_7H_{14}	0.69410	0.68966	0.68517	0.000893	99.88 ± 0.09
4	4,4-Dimethyl-1-pentene	C_7H_{14}	0.68249	0.67804	0.67351	0.000898	99.85 ± 0.08
5	2,4-Dimethyl-2-pentene	C_7H_{14}	0.69492	0.69052	0.68591	0.000901	99.88 ± 0.04
6	4,4-Dimethyl-*cis*-2-pentene	C_7H_{14}	0.69943	0.69510	0.69061	0.000882	99.85 ± 0.11
7	4,4-Dimethyl-*trans*-2-pentene	C_7H_{14}	0.68885	0.68430	0.67954	0.000931	99.91 ± 0.03
8	3-Methyl-2-ethyl-1-butene	C_7H_{14}	0.70878	0.70429	0.69968	0.000910	99.85 ± 0.10
9	2,3,3-Trimethyl-1-butene	C_7H_{14}	0.70466	0.70024	0.69573	0.000893	99.95 ± 0.04
10	2,2-Dimethyl-*cis*-3-hexene	C_8H_{16}	0.71251	0.70835	0.70416	0.000835	99.86 ± 0.12
11	2,2-Dimethyl-*trans*-3-hexene	C_8H_{16}	0.70382	0.69931	0.69483	0.000899	99.85 ± 0.10
12	2-Methyl-3-ethyl-1-pentene	C_8H_{16}	0.72468	0.72060	0.71640	0.000828	99.81 ± 0.08
13	2,4,4-Trimethyl-1-pentene	C_8H_{16}	0.71497	0.71089	0.70654	0.000843	99.95 ± 0.03
14	2,4,4-Trimethyl-2-pentene	C_8H_{16}	0.72123	0.71694	0.71259	0.000864	99.95 ± 0.03
15	1-Methylcyclohexene	C_7H_{12}	0.81148	0.80660	0.80230	0.000918	99.86 ± 0.08
16	1-Ethylcyclohexene	C_8H_{14}	0.82214	0.81767	0.81350	0.000864	99.90 ± 0.09

[a] For air-saturated material at 1 atm.

Table II. Values of Constants of Modified Cauchy Equation

Compd. No.	Constants in Equation $\Delta n = a + b/\lambda^2$: $a \times 10^3$ at ° C. 20–25	25–30	$b \times 10^3$ at ° C. 20–25	25–30	$\rho \times 10^5$ at ° C. 20–25	25–30
1	2.567	2.567	0.0415	0.0415	3.34	2.53
2	2.671	2.671	0.0120	0.0120	5.38	4.10
3	2.724	2.724	0.0089	0.0089	1.77	2.42
4	2.730	2.730	0.0154	0.0154	2.69	2.54
5	2.750	2.750	0.0202	0.0202	3.54	3.56
6	2.693	2.693	0.0076	0.0076	3.59	2.45
7	2.771	2.771	0.0175	0.0175	3.54	3.68
8	2.680	2.680	0.0196	0.0196	4.46	3.89
9	2.725	2.725	0.0080	0.0080	3.54	4.26
10	2.463	2.463	0.0286	0.0286	5.33	4.88
11	2.603	2.603	0.0360	0.0360	4.29	4.87
12	2.422	2.422	0.0242	0.0242	2.78	3.40
13	2.492	2.492	0.0152	0.0152	3.12	3.25
14	2.530	2.530	0.0162	0.0162	7.12	6.27
15	2.607	2.765	0.0034	0.0215	1.64	1.84
16	2.263	2.380	0.0348	0.0599	4.60	5.77

Table III. Values of Constants of Modified Hartmann Equation

Compd. No.	Constants in Equation $n_\lambda = n_\infty + C/(\lambda - \lambda^*)^{1.6}$ at 25° C. n_∞	C	λ^*	$\rho \times 10^5$
1	1.39652	0.004078	0.11442	1.12
2	1.39456	0.004219	0.10907	2.45
3	1.38288	0.004036	0.10531	2.25
4	1.37624	0.004030	0.10154	1.75
5	1.38758	0.004065	0.11305	2.08
6	1.38639	0.004357	0.09599	1.77
7	1.38257	0.003876	0.11261	1.58
8	1.38974	0.003918	0.10979	1.82
9	1.38740	0.003889	0.11119	1.32
10	1.39446	0.004032	0.10942	0.80
11	1.39068	0.003961	0.11066	1.54
12	1.39733	0.003880	0.11041	1.12
13	1.39333	0.003900	0.11267	1.27
14	1.40001	0.004230	0.10793	2.15
15	1.43316	0.004550	0.10831	1.69
16	1.44006	0.004326	0.11478	1.86

Table IV. Values of Refractive Index

Compd. No.	Temp., °C.	Wave Length, Angstrom Units: 6678.1	6562.8	5892.6	5460.7	5015.7	4861.3	4358.3
		Spectral Line: He_{red}	H_C	Na_D	Hg_e	He_{blue}	H_F	Hg_g
1	20	1.40969	1.41005	1.41264	1.41487	1.41786	1.41913	1.42437
	25	1.40703	1.40739	1.40995	1.41216	1.41513	1.41639	1.42159
	30	1.40437	1.40473	1.40726	1.40945	1.41240	1.41365	1.41881
2	20	1.40797	1.40833	1.41090	1.41313	1.41612	1.41737	1.42252
	25	1.40527	1.40563	1.40820	1.41042	1.41340	1.41465	1.41982
	30	1.40257	1.40293	1.40550	1.40771	1.41068	1.41193	1.41709
3	20	1.39575	1.39610	1.39852	1.40060	1.40339	1.40455	1.40938
	25	1.39301	1.39336	1.39577	1.39785	1.40063	1.40179	1.40661
	30	1.39027	1.39062	1.39302	1.39510	1.39787	1.39903	1.40384
4	20	1.38901	1.38934	1.39172	1.39376	1.39649	1.39763	1.40231
	25	1.38625	1.38658	1.38895	1.39098	1.39370	1.39483	1.39950
	30	1.38349	1.38382	1.38618	1.38820	1.39091	1.39203	1.39669
5	20	1.40081	1.40117	1.40371	1.40591	1.40886	1.41011	1.41526
	25	1.39801	1.39837	1.40090	1.40309	1.40603	1.40727	1.41240
	30	1.39521	1.39557	1.39809	1.40027	1.40320	1.40443	1.40954
6	20	1.39975	1.40011	1.40260	1.40474	1.40757	1.40875	1.41362
	25	1.39704	1.39740	1.39989	1.40202	1.40485	1.40603	1.41089
	30	1.39433	1.39469	1.39718	1.39930	1.40213	1.40331	1.40816
7	20	1.39532	1.39566	1.39807	1.40017	1.40297	1.40415	1.40905
	25	1.39251	1.39285	1.39525	1.39734	1.40013	1.40131	1.40619
	30	1.38970	1.39004	1.39243	1.39451	1.39729	1.39847	1.40333
8	20	1.40242	1.40276	1.40518	1.40725	1.41005	1.41121	1.41606
	25	1.39970	1.40004	1.40244	1.40451	1.40729	1.40845	1.41328
	30	1.39698	1.39732	1.39970	1.40177	1.40453	1.40569	1.41050
9	20	1.40007	1.40041	1.40282	1.40489	1.40768	1.40884	1.41370
	25	1.39733	1.39767	1.40007	1.40214	1.40492	1.40608	1.41093
	30	1.39459	1.39493	1.39732	1.39939	1.40216	1.40337	1.40816
10	20	1.40723	1.40758	1.41005	1.41220	1.41507	1.41627	1.42125
	25	1.40470	1.40505	1.40751	1.40964	1.41249	1.41369	1.41864
	30	1.40217	1.40252	1.40497	1.40708	1.40991	1.41111	1.41603
11	20	1.40346	1.40381	1.40627	1.40838	1.41123	1.41243	1.41737
	25	1.40078	1.40112	1.40356	1.40566	1.40848	1.40967	1.41458
	30	1.39810	1.39843	1.40085	1.40294	1.40573	1.40691	1.41179
12	20	1.40969	1.41003	1.41242	1.41449	1.41727	1.41843	1.42326
	25	1.40721	1.40755	1.40993	1.41199	1.41475	1.41591	1.42071
	30	1.40473	1.40507	1.40744	1.40949	1.41223	1.41339	1.41816
13	20	1.40586	1.40620	1.40864	1.41073	1.41355	1.41475	1.41967
	25	1.40333	1.40367	1.40610	1.40819	1.41100	1.41219	1.41710
	30	1.40080	1.40114	1.40356	1.40565	1.40845	1.40963	1.41453
14	20	1.41328	1.41364	1.41622	1.41843	1.42140	1.42265	1.42782
	25	1.41071	1.41107	1.41364	1.41585	1.41881	1.42005	1.42520
	30	1.40814	1.40850	1.41106	1.41327	1.41622	1.41745	1.42258
15	20	1.44730	1.44769	1.45046	1.45284	1.45603	1.45737	1.46293
	25	1.44468	1.44507	1.44784	1.45022	1.45341	1.45475	1.46030
	30	1.44187	1.44225	1.44501	1.44738	1.45071	1.45189	1.45742
16	20	1.45356	1.45394	1.45668	1.45905	1.46224	1.46358	1.46914
	25	1.45122	1.45160	1.45432	1.45667	1.45984	1.46117	1.46670
	30	1.44870	1.44908	1.45177	1.45409	1.45722	1.45854	1.46400

Table V. Calculated Values of Specific Dispersion

Temp., °C.	$10^4(n_F - n_C)/d$	$10^4(n_g - n_D)/d$	$10^4(n_F - n_C)/d$	$10^4(n_g - n_D)/d$	$10^4(n_F - n_C)/d$	$10^4(n_g - n_D)/d$	$10^4(n_F - n_C)/d$	$10^4(n_g - n_D)/d$
	3-Methyl-*cis*-3-hexene		3-Methyl-*trans*-3-hexene		2,3,3-Trimethyl-1-butene		2,2-Dimethyl-*cis*-3-hexene	
20	127.372	164.546	126.811	163.003	119.632	154.401	121.963	157.191
25	127.128	164.418	127.410	164.136	120.102	155.090	121.974	157.126
30	126.681	164.032	127.817	164.600	121.311	155.808	121.989	157.067
	2,4-Dimethyl-1-pentene		4,4-Dimethyl-1-pentene		2,2-Dimethyl-*trans*-3-hexene		2-Methyl-3-ethyl-1-pentene	
20	121.740	156.462	121.467	155.167	122.474	157.711	115.913	149.583
25	122.234	157.179	121.674	155.596	122.263	157.584	116.014	149.598
30	122.734	157.917	121.899	156.048	122.044	157.449	116.136	149.637
	2,4-Dimethyl-2-pentene		4,4-Dimethyl-*cis*-2-pentene		2,4,4-Trimethyl-1-pentene		2,4,4-Trimethyl-2-pentene	
20	128.648	166.206	123.529	157.557	119.585	154.272	124.925	160.836
25	128.888	166.541	124.155	158.251	119.850	154.736	125.255	161.241
30	129.171	166.932	124.817	158.989	120.163	155.264	125.598	161.664
	4,4-Dimethyl-*trans*-2-pentene		3-Methyl-2-ethyl-1-butene		1-Methylcyclohexene		1-Ethylcyclohexene	
20	123.249	159.346	119.219	153.503	119.288	153.670	117.255	151.556
25	123.630	159.871	119.411	153.914	120.010	154.476	117.040	151.406
30	124.055	160.403	119.626	154.356	120.154	154.680	116.288	150.338

Table VI. Values of Experimental Pressures and Temperatures, Calculated Temperatures, and Δt

P, Mm. Hg. Exptl.	Temp., ° C. Exptl.	Calcd.	$\Delta t^a \times 10^3$
3-Methyl-*cis*-3-hexene			
756.91	95.257	95.264	−7
735.44	94.314	94.298	+16
502.99	82.065	82.088	−23
403.33	75.423	75.423	0
323.86	69.093	69.091	+2
261.23	63.178	63.151	+27
214.11	57.870	57.871	−1
171.63	52.226	52.231	−5
145.85	48.205	48.227	−22
118.62	43.327	43.313	+14
98.12	38.964	38.960	+4
81.91	34.966	34.952	+14
62.44	29.122	29.160	−38
2,4-Dimethyl-1-pentene			
769.61	82.029	82.030	−1
756.93	81.478	81.475	+3
747.07	81.040	81.039	+1
735.45	80.517	80.519	−2
630.22	75.486	75.488	−2
502.99	68.434	68.434	0
403.33	61.848	61.844	+4
323.88	55.583	55.586	−3
261.22	49.714	49.715	−1
214.11	44.507	44.502	+5
171.62	38.926	38.933	−7
145.85	34.959	34.983	−24
118.62	30.158	30.135	+23
98.12	25.854	25.842	+12
81.90	21.933	21.888	+45
71.44	18.972	18.981	−9
62.44	16.123	16.182	−59
2,4-Dimethyl-2-pentene			
769.61	83.715	83.713	+2
756.97	83.183	83.169	+14
747.08	82.756	82.738	+18
735.47	82.213	82.227	−14
630.22	77.251	77.276	−25
502.96	70.319	70.332	−13
403.30	63.855	63.843	+12
323.94	57.684	57.688	−4
261.19	51.892	51.896	−4
214.06	46.774	46.756	+18
171.57	41.277	41.267	+10
145.82	37.367	37.375	−8
118.60	32.610	32.597	+13
98.12	28.379	28.368	+11
81.88	24.490	24.462	+28
71.42	21.571	21.593	−22
62.36	18.736	18.812	−76
4,4-Dimethyl-*trans*-3-hexene			
769.61	77.154	77.149	+5
757.06	76.613	76.614	−1
747.09	76.186	76.184	+2
735.51	75.677	75.679	−2
630.21	70.768	70.774	−6
502.90	63.886	63.894	−8
403.26	57.492	57.467	+25
323.84	51.362	51.363	−1
261.12	45.605	45.625	−20
213.99	40.536	40.529	+7
171.49	35.093	35.085	+8
145.74	31.214	31.225	−11
118.58	26.483	26.496	−13
98.14	22.309	22.310	−1
81.88	18.473	18.433	+40
71.36	15.551	15.570	−19

P, Mm. Hg. Exptl.	Temp., ° C. Exptl.	Calcd.	$\Delta t^a \times 10^3$
3-Methyl-*trans*-3-hexene			
769.61	93.966	93.966	0
756.95	93.410	93.407	+3
747.07	92.965	92.965	0
735.46	92.440	92.441	−1
630.22	87.359	87.360	−1
502.97	80.228	80.231	−3
403.31	73.567	73.566	+1
323.91	67.227	67.238	−11
261.21	61.283	61.290	−7
214.08	56.042	56.005	+37
171.60	50.356	50.360	−4
145.83	46.338	46.354	−16
118.61	41.439	41.436	+3
98.12	37.085	37.081	+4
81.89	33.086	33.062	+24
71.43	30.089	30.108	−19
62.43	27.240	27.264	−24
4,4-Dimethyl-1-pentene			
769.62	72.932	72.936	−4
756.95	72.386	72.385	+1
747.08	71.950	71.951	−1
735.46	71.435	71.434	+1
630.23	66.440	66.439	+1
502.98	59.443	59.440	+3
403.32	52.911	52.906	+5
323.90	46.700	46.709	−9
261.22	40.894	40.896	−2
214.10	35.743	35.736	+7
171.61	30.229	30.230	−1
145.84	26.319	26.327	−8
118.61	21.551	21.539	+12
98.12	17.299	17.303	−4
4,4-Dimethyl-*cis*-2-pentene			
769.61	80.853	80.853	0
757.06	80.300	80.300	0
747.09	79.857	79.856	+1
735.50	79.332	79.335	−3
630.21	74.273	74.273	0
502.90	67.180	67.177	+3
403.25	60.559	60.554	+5
323.84	54.261	54.269	−8
261.12	48.367	48.365	+2
213.99	43.140	43.125	+15
171.49	37.517	37.529	−12
145.74	33.567	33.565	+2
118.57	28.675	28.708	−33
98.14	24.422	24.415	+7
81.88	20.472	20.438	+34
71.36	17.500	17.504	−4
3-Methyl-2-ethyl-1-butene			
769.61	86.789	86.785	+4
757.06	86.236	86.236	0
747.10	85.796	85.795	+1
735.50	85.273	85.276	−3
630.21	80.241	80.241	0
502.89	73.183	73.180	+3
403.24	66.588	66.588	0
323.82	60.315	60.329	−14
261.11	54.449	54.449	0
213.99	49.238	49.230	+8
171.49	43.660	43.654	+6
145.74	39.698	39.703	−5
118.57	34.872	34.861	+11
98.13	30.579	30.578	+1
81.89	26.657	26.617	+40
71.35	23.675	23.684	−9
62.35	20.876	20.880	−4
51.86	17.094	17.154	−60

Table VI. Continued

P, Mm. Hg. Exptl.	Temp., ° C. Exptl.	Temp., ° C. Calcd.	$\Delta t \times 10^3$
2,3,3-Trimethyl-1-butene			
769.61	78.313	78.312	+1
757.06	77.761	77.762	−1
747.10	77.321	77.320	+1
735.50	76.799	76.800	−1
630.21	71.759	71.760	−1
502.89	64.694	64.694	0
403.24	58.102	58.099	+3
323.82	51.834	51.841	−7
261.11	45.966	45.964	+2
213.99	40.761	40.750	+11
171.49	35.191	35.181	+10
145.74	31.198	31.236	−38
118.57	26.409	26.402	+7
98.13	22.129	22.128	+1
81.90	18.207	18.179	+28
71.35	15.232	15.250	−18
2,2-Dimethyl-*trans*-3-hexene			
769.62	101.327	101.326	+1
757.06	100.760	100.759	+1
747.12	100.306	100.306	0
735.51	99.766	99.770	−4
630.21	94.583	94.581	+2
502.86	87.304	87.303	+1
403.22	80.513	80.510	+3
323.75	74.051	74.055	−4
261.07	68.000	67.998	+2
214.00	62.628	62.624	+4
171.50	56.877	56.878	−1
145.74	52.793	52.804	−11
118.55	47.816	47.810	+6
98.09	43.379	43.390	−11
81.94	39.333	39.330	+3
71.32	36.277	36.284	−7
62.31	33.387	33.391	−4
51.81	29.575	29.544	+31
2,4,4-Trimethyl-1-pentene			
769.62	101.914	101.908	+6
757.06	101.326	101.326	0
747.13	100.860	100.860	0
735.51	100.307	100.308	−1
630.21	94.965	94.971	−6
502.82	87.479	87.483	−4
403.18	80.493	80.495	−2
323.68	73.854	73.854	0
261.02	67.636	67.626	+10
214.00	62.121	62.106	+15
171.51	56.214	56.198	+16
145.74	51.979	52.008	−29
118.53	46.862	46.868	−6
98.05	42.296	42.318	−22
81.99	38.143	38.167	−24
71.28	35.008	35.009	−1
62.27	32.058	32.033	+25
51.75	28.103	28.067	+36
1-Methylcyclohexene			
769.60	110.743	110.741	+2
757.03	110.157	110.157	0
747.12	109.690	109.691	−1
735.49	109.137	109.138	−1
630.18	103.783	103.786	−3
502.76	96.270	96.270	0
403.13	89.255	89.253	+2
323.59	82.578	82.573	+5
260.97	76.317	76.311	+6
214.01	70.760	70.761	−1
171.51	64.805	64.810	−5
145.74	60.572	60.586	−14
118.51	55.409	55.399	+10
98.00	50.807	50.800	+7
82.04	46.607	46.636	−29
71.24	43.373	43.419	−46
62.23	40.429	40.411	+18
51.69	36.463	36.392	+71

P, Mm. Hg. Exptl.	Temp., ° C. Exptl.	Temp., ° C. Calcd.	$\Delta t \times 10^3$
2,2-Dimethyl-*cis*-3-hexene			
769.62	105.895	105.887	+8
757.06	105.306	105.302	+4
747.12	104.839	104.834	+5
735.51	104.280	104.281	−1
630.21	98.905	98.926	−21
502.84	91.404	91.417	−13
403.21	84.437	84.415	+22
323.73	77.754	77.766	−12
261.05	71.532	71.530	+2
214.00	66.021	66.004	+17
171.50	60.102	60.095	+7
145.74	55.904	55.908	−4
118.54	50.783	50.776	+7
98.08	46.228	46.237	−9
81.96	42.058	42.078	−20
71.30	38.932	38.941	−9
62.30	35.955	35.976	−21
51.79	32.055	32.027	+28
2-Methyl-3-ethyl-1-pentene			
769.62	109.709	109.704	+5
757.06	109.119	109.118	+1
747.12	108.647	108.648	−1
735.51	108.090	108.093	−3
630.21	102.713	102.716	−3
502.82	95.167	95.171	−4
403.18	88.129	88.127	+2
323.67	81.429	81.429	0
261.02	75.153	75.148	+5
214.00	69.579	69.579	0
171.51	63.617	63.617	0
145.74	59.377	59.387	−10
118.53	54.205	54.198	+7
98.05	49.611	49.603	+8
82.00	45.405	45.413	−8
71.28	42.236	42.220	+16
62.27	39.235	39.213	+32
51.75	35.157	35.205	−48
2,4,4-Trimethyl-2-pentene			
769.62	105.351	105.352	−1
757.05	104.776	104.776	0
747.14	104.315	104.317	−2
735.51	103.772	103.772	0
630.20	98.500	98.503	−3
502.77	91.107	91.105	+2
403.14	84.206	84.203	+3
323.58	77.640	77.635	+5
260.97	71.491	71.484	+7
214.01	66.031	66.034	−3
171.52	60.186	60.193	−6
145.74	56.032	56.048	−16
118.53	50.968	50.960	+8
98.00	46.445	46.451	−6
82.05	42.335	42.373	−38
71.23	39.224	39.215	+9
62.23	36.277	36.271	+6
51.68	32.392	32.332	+60
1-Ethylcyclohexene			
769.61	137.464	137.462	+2
757.04	136.845	136.847	−2
747.12	136.353	136.355	−2
735.49	135.769	135.772	−3
630.19	130.135	130.135	0
502.77	122.228	122.219	+9
403.14	114.830	114.829	+1
323.60	107.796	107.795	+1
260.98	101.206	101.202	+4
214.01	95.352	95.358	−6
171.51	89.085	89.093	−8
145.74	84.629	84.648	−19
118.51	79.198	79.188	+10
98.01	74.347	74.351	−4
82.04	69.946	69.966	−20
71.24	66.612	66.582	+30
62.24	63.440	63.420	+20
51.70	59.196	59.192	+4

[a] Δt is exptl. temp. minus calcd. temp.

Table VII. Summary of Results of Correlation of Experimental Data with Antoine Equation for Vapor Pressure

Compd. No.	Const. of Antoine Equation $\log_{10}P = A - B/(C + t)$ or $t = B/(A - \log_{10}P) - C$ A	B	C	760 Mm. Hg., ° C. Normal b.p. at	Pressure Coeff. dt/dP at	Range of Measurement Pressure, mm. Hg.	Temp. ° C.	Measure of Precision, ρ
1	6.8778781	1239.8574	214.79055	95.401	0.044347	62 to 760	29.1 to 95.4	1.80
2	6.8962316	1250.6891	217.92926	93.542	0.044326	62 to 770	27.2 to 94.0	1.29
3	6.8326176	1199.9821	222.04380	81.610	0.043909	62 to 770	16.1 to 82.1	1.23
4	6.7641754	1150.9965	223.87364	72.518	0.043614	98 to 770	17.2 to 73.0	0.58
5	6.8593296	1196.5597	217.45513	83.300	0.043198	62 to 770	18.7 to 83.8	2.03
6	6.8074915	1191.5111	223.00968	80.430	0.044159	71 to 770	17.5 to 80.9	1.04
7	6.8767641	1195.1692	222.35475	76.740	0.042772	71 to 770	15.5 to 77.2	1.45
8	6.8368499	1202.7776	217.67062	86.365	0.043917	51 to 770	17.0 to 86.8	1.02
9	6.7982561	1181.0491	223.59327	77.891	0.043978	71 to 770	15.2 to 78.3	1.07
10	6.7777147	1241.7401	213.20819	105.440	0.046726	51 to 770	32.0 to 105.9	1.48
11	6.8388296	1240.6829	212.56819	100.893	0.045256	51 to 770	29.5 to 101.4	0.54
12	6.8645183	1302.0777	217.59540	109.256	0.046885	51 to 770	35.1 to 109.8	0.74
13	6.8345721	1273.4163	220.61461	101.463	0.046550	51 to 770	28.1 to 102.0	1.16
14	6.8592192	1272.7167	214.99451	104.912	0.045950	51 to 770	32.3 to 105.4	0.97
15	6.9124110	1326.9128	218.83255	110.296	0.046651	51 to 770	36.4 to 110.8	1.16
16	6.9000850	1389.3687	208.68444	136.992	0.049147	51 to 770	59.1 to 137.5	0.85

Table V gives the values of the specific dispersions, $10^4(n_F - n_C)/d$ and $10^4(n_g - n_D)/d$, calculated from the values of refractive index in Table IV and of density in Table I.

The measurements of vapor pressures and boiling points were made as previously described (*1, 11*), the samples being introduced into the apparatus without contact with the air of the atmosphere.

Using the experimental data and the method of least squares, calculations were made to yield constants for the Antoine equation for vapor pressure:

$$\log_{10}P = A - B/(C + t)$$

The method of calculating constants for the Antoine equation for vapor pressure as previously described (*11*) was modified, and programmed for the IBM 650 computer. This program will be described in detail in another report (*2*).

Table VI gives the experimental data on the temperature and pressures of the liquid-vapor equilibrium, the calculated temperatures at the experimental pressures and Δt, the experimental temperature minus the calculated temperature, for the compounds measured.

Table VII gives the values of the three constants of the Antoine equation, the normal boiling point at 760 mm. of mercury, the pressure coefficient of the boiling point at 760 mm. of mercury, and the range of measurement in pressure and in temperature. The last column of Table VII gives the root mean square value of the ratios of the deviations of the observed points from the Antoine equation to the expected standard deviation. Individual measurements of boiling points were reproducible within ±0.002° to ±0.003° C. The accuracy of the tabulated values of the normal boiling point is estimated to be ±0.008° to ±0.015° C.

Table VIII. Calculated Values of Heats of Vaporization at 25° C. and Normal Boiling Point at Saturation Pressure

Compd. No.	Heat of Vaporization at Satn. Pressure 25° C., kcal./mole	Normal b.p., kcal./mole	Normal B.P., 760 Mm. Hg., ° C.
1	8.71	7.52	95.401
2	8.56	7.45	93.542
3	7.91	6.98	81.610
4	7.45	6.75	72.518
5	8.20	7.24	83.300
6	7.79	6.97	80.430
7	7.85	7.05	76.740
8	8.23	7.24	86.365
9	7.68	6.90	77.891
10	8.86	7.52	105.440
11	8.89	7.59	100.893
12	8.96	7.64	109.256
13	8.53	7.40	101.463
14	8.94	7.63	104.912
15	9.04	7.72	110.296
16	10.33	8.34	136.992

CALCULATION OF HEATS OF VAPORIZATION

It appeared desirable to utilize the data on the change of vapor pressure with temperature, in combination with reliable estimates of the difference in the molal volumes of the gas and liquid phases, to calculate values of the heats of vaporization, given in Table VIII, for the 16 alkenes. The method of calculation was that previously described (*1*).

CONCLUSION

The 16 alkene hydrocarbons measured in this investigation have been deliberately selected, from the standpoint of their structural features, to add to what is already available to permit calculation of the properties of substantially all of the remaining C_7 and C_8 and higher alkene hydrocarbons. This work of correlating the properties is now under way.

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