ENCLOSURE (A)

Part III
SOME TABULATED PHYSICAL PROPERTIES
OF IMPORTANT HYDROCARBONS

A. PHYSICAL PROPERTIES OF PURE HYDROCARBONS

Compound	Formula	B.P.(°C)	d_4^{25}	n_D^{25}	O.N.
n-hexane	C_6H_{14}	69.1-69.3	0.6558	1.3730	36 (1)
2-methyl pentane	C_6H_{14}	61 -63	0.6535		(1)
2-2-dimethyl butane	C_6H_{14}	50 -51.9	0.6468	1.36252	(1)
2-3-dimethyl butane	C_6H_{14}	57 - 58	0.6569	1.3708	95 (1)
3-ethyl pentane	C_7H_{16}	91.5-93.5	0.6929	1.3900	(1)
2-2-dimethyl pentane	C_7H_{16}	78 - 82	0.6712	1.3815	(1)
3-3-dimethyl pentane	C_7H_{16}	84 - 88	0.6881	1.3892	(1)
2-3-dimethyl pentane	C_7H_{16}	90 - 93	0.689	1.5873	(1)
3-methyl 3-ethyl pentane	C_8H_{18}	115- 120	0.7192	1.4031	(1)
3-3-dimethyl hexane	C_8H_{18}	109 - 115	0.7126	1.3981	(1)
3-4-dimethyl hexane	C_8H_{18}	113- 118	0.7182	1.4052	(2)
2-2-3-trimethyl butane	C_7H_{16}				104 (2)
2-2-3-trimethyl pentane	C_8H_{18}				101 (2)
2-3-4-trimethyl pentane	C_8H_{18}				97 (2)
			d_4^{20}	n_D^{20}	(5)
2-2-4-trimethyl pentane	C_8H_{18}	99.3	0.6921	1.3916	
n-heptane	C_7H_{16}	98.4	0.6836	1.3777	(5)
			d_4^{25}	n_D^{25}	
2-3-methyl 3-ethyl pentane	C_8H_{18}	114 - 119	0.702	1.400	(3)
2-3-dimethyl hexane	C_8H_{18}		0.07	1.404	(3)

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Compound	Formula	B.P.(°C)	d_4^{25}	n_D^{25}	O.N.	
3-4-dimethyl hexane	C_8H_{18}	117	0.714	1.407		(3)
2-5-dimethyl hexane	C_8H_{18}	108 - 110	0.7004	1.3947		(3)
2-methyl hexane	C_7H_{16}	87 - 91	.6882	1.3862		(3)
Decane	$C_{10}H_{22}$	170 - 172	0.7270	1.4100		(4)
2-6-dimethyl octene	$C_{10}H_{20}$	160 - 161	0.7450	1.4250		(4)
Hexadecane	$C_{16}H_{34}$	140 - 144/11	0.7703	1.4321		(4)
Benzene	C_6H_6	80.2 - 80.6	0.8715	1.4960	103.3	(6)
Methyl Benzene	$C_6H_5CH_3$	109.8-109.9	0.8611	1.4912	110	(6)
Ethyl Benzene	$C_6H_5C_2H_5$	134.5-135	0.8630	1.4913		(7)
Propyl Benzene	$C_6H_5C_3H_7$	156 - 157	0.8577	1.4878	102	(7)
Isopropyl Benzene	$C_6H_5C_3H_7$	150.2-150.8	0.8575	1.4874	102	(7)
Butyl Benzene	$C_6H_5C_4H_9$	179 - 179.5	0.8567	1.4857	102	(7)
Isobutyl Benzene	$C_6H_5C_4H_9$	169.5-170.5	0.8570	1.4852	102	(7)
Tert. Butyl Benzene		165 - 166	0.8627	1.4885	102	(7)
o-xylene	$C_6H_4(CH_3)_2$	141.9-142	0.8509	1.4850		(6)
p-O-Xylene	$C_6H_4(CH_3)_2$	136.3	0.8566	1.4920	108	(6)
m-O-Xylene	$C_6H_4(CH_3)_2$	138 - 138.3	0.8600	1.4931	108	(6)
p-cymene	$C_6H_4(CH_3)(C_3H_7)$	173.9-174.1	0.8528	1.4869		(8)
p-Di Tert. Butyl	$C_6H_4(C_3H_7)_2$	230 - 233			108	(9)
n-Amyl Benzene	$C_6H_5C_5H_{11}$	204 - 5°	0.8694	1.4838		(10)
n-Nonyl Benzene	$C_6H_5C_9H_{19}$	280 - 281	0.8572	1.4799		(10)
n-Octadecyl	$C_6H_5C_{18}H_{37}$	(235)15	0.8085	1.4469		(10)
Styrene	C_8H_8	143 - 145°	0.8979	1.5378		(10)
Diphenyl	$C_{12}H_{10}$	248 - 9°				(11)
1-4-Diphenyl benzene	$C_{18}H_{14}$	211.5-212				(11)
1-3-Diphenyl benzene	$C_{18}H_{14}$	85.5 - 86.5				(11)
Anthracene	$C_{14}H_{10}$	212.5-213.5				(11)
Phenanthrene	$C_{14}H_{10}$	97 - 98				(11)
Acenaphthene	$C_{12}H_{10}$	266.5-267.5				(11)
Pyrene	$C_{16}H_{10}$	148 - 149				(11)

ENCLOSURE (A)

Compound	Formula	B.P.(°C)	d_4^{25}	n_D^{25}	O.N.	
Cyclo Pentane	C_5H_{10}	48.9 - 50°	0.7422			(12)
Cyclo Pentene	C_5H_8	45 - 60	0.7422	1.4039	78.8	(6)
Cyclo Hexane	C_6H_{12}	80.7 - 81.0	0.7736	1.4218	65	(6)
Cyclo Hexene	C_6H_{10}	83.1 - 83.4	0.8059	1.4430	75	(6)
Methyl Cyclo Hexane	$C_6H_{11}CH_3$	100 - 103	0.7619	1.4191		(6)
Ethyl Cyclo Hexane	$C_6H_{11}C_2H_3$	120 - 30	0.8154	1.4568	75	(6)
Menthane	$C_{10}H_{20}$					
Δ3 menthene	$C_{10}H_{18}$	168 - 169.5	0.8107	1.4487	$(a)_D$ +107.24	

		B.P.(°C)	D_4^{25}	n_D^{25}	M.R.	M.V.	
Cyclo Hexane	C_6H_{10}	81.5 - 82	0.8064	1.4434	27.03	101.49	(13)
Methylcyclo HexaneΔ1	C_7H_{12}	109 - 110	0.8050	1.4462	31.81	119.25	(13)
Methylcyclo HexaneΔ2	C_7H_{12}	104.5 - 105	0.7970	1.4413	31.83	120.45	(13)
Methylcyclo HexaneΔ3	C_7H_{12}	101.5 - 102	0.7951	1.4385	31.77	120.74	(13)
Phenyl Cyclo Hexane	$C_{12}H_{16}$	234 - 60	0.9431	1.5313	52.56		(15)
Di Cyclo Hexyl	$C_{12}H_{22}$	231 - 3°	0.8836	1.4777	53.20		(15)
Hexahydro-1-3-Diphenyl Benzene	$C_{18}H_{20}$	176 - 8/2.6	1.0102	1.5798	77.78		(15)
Dodecahydro-1-3-Diphenyl Benzene	$C_{18}H_{26}$	176 - 8/2	0.9742	1.5425	78.31		(15)
Perhydro-1-3-Diphenyl Benzene	$C_{18}H_{32}$	182 - 4/5	0.9443	1.5176	79.61		(15)
Hexahydro-1-4-Diphenyl Benzene	$C_{18}H_{20}$	178-108/1.5					
Dodecahydro-1-4-Diphenyl Benzene	$C_{18}H_{26}$	178-180/1.8 96 - 97					
Perhydro-1-4-Diphenyl Benzene	$C_{18}H_{32}$	130-134/2.5 48 - 49					
Dihydro Anthracene	$C_{14}H_{12}$	108.5	1.1675	1.5776	180.1		(14)
Tetra Hydro Anthracene	$C_{14}H_{14}$	79	1.1047	1.5571	182.1		(14)
Tetra Hydro Anthracene	$C_{14}H_{14}$	88	1.1176	1.5686	182.1		(14)

ENCLOSURE (A)

Compound	Formula	B.P.(°C)	d_4^{25}	n_D^{25}	M.R.	
Octa Hydro-Anthracene	$C_{14}H_{20}$ $C_{14}H_{20}$	71	0.9450	1.5671	192.2	(14)
Perhydro Anthracene	$C_{14}H_{24}$	(115-125)2.5	1.0338	1.4826	192.2	(14)
Tetra Hydro-phenanthrene	$C_{14}H_{14}$	160-162/10.9	1.0706	1.6260	60.12	
Octahydro-phenanthrene	$C_{14}H_{20}$	159-160/12	1.0167	1.5620	59.38	
Perhydro-phenanthrene	$C_{14}H_{24}$	132-134/10.7	0.9502	1.5020	59.69	
Tetrahydro-Acenaphthene	$C_{12}H_{13}$	245 - 247	1.0065	1.5550	50.42	(11)
Dodecahydro-Acenaphthene	$C_{12}H_{19}$	235 - 237	0.9462	1.5020	51.20	
Hexahydro-pyrene	$C_{12}H_{16}$	131 - 132				
Dodecahydro-pyrene	$C_{16}H_{20}$	158 - 160/3	1.0497	1.5742	66.71	
Perhydro-pyrene	$C_{16}H_{20}$	144 - 148/4	0.9835	1.5230	67.63	
Diphenyl-methane	$C_{13}H_{12}$	170/5	1.0042	1.5763	55.42	(16)
Benzyl-benzene	$C_{20}H_{18}$		1.0467	1.6020	84.64	
Dibenzyl Diphenyl Methane	$C_{27}H_{20}$		1.0683	1.6170	114.04	
Dodocahydro-diphenyl Methane	$C_{13}H_{20}$	224-4.5/745	0.8723	1.4747	58.07	
Octadecahydro-dibenzyl Benzene	$C_{20}H_{36}$	169-173/2.2	0.9127	1.4940	88.19	
Tetracocahydro-dibenzyl-diphenyl-methane	$C_{27}H_{48}$	240-280/5	0.9492	1.5206	119.38	

Compound	Formula	B.P.(°C)	d_4^{25}	n_D^{25}	
Naphthalene	$C_{10}H_8$				
Δ_2Dihydro Naphthalene	$C_{10}H_{10}$	206.5-207	0.9926	1.5782	(17)
Tetrahydro Naphthalene	$C_{10}H_{12}$	204 -204.3	0.9644	1.5408	(17)
Cis Octa-hydronaphthalene	$C_{10}H_{16}$	191 - 191.5	0.9135	1.4918	(17)
Cis Decahydro-naphthalene	$C_{10}H_{18}$	189.8-190	0.8905	1.4770	(17)

ENCLOSURE (A)

Compound	Formula	B.P.(°C)	d_4^{25}	n_D^{25}		
Deca Hydro Cadalene	$C_{15}H_{28}$	(97 - 100)$_4$	0.8730	1.4745		(18
Tetrahydro Cadalene	$C_{15}H_{22}$	(108 - 118)$_4$	0.907	1.506		
Dihydro Cadalene	$C_{15}H_{20}$	(108 - 114)$_{4.5}$	0.9150	1.5085	$(\alpha)_D$ -224	
a-methyl Naphthalene	$C_{10}H_7OH_3$	(238 - 9.20)	1.0173	1.6120		(19)
Δ^2 Dihydro Methyl Naphthalene	$C_{10}H_9OH_3$	(122 - 125)$_{29}$	0.9898	1.5710		
Longifolene	$C_{15}H_{24}$	(114 - 6)$_{10}$	0.9317	1.5041	+42.2	(20)
Trans-Decahydro Naphthalene	$C_{10}H_{18}$	185 - 9°	0.8748	1.4701		

Notes

(1) T. NAKAYAMA: Alkylation of acetone, methyl ethyl ketone.
(2) ISHIDA: Alkylation of ketone.
(3) S. KOMATSU & T. NAKAYAMA: Alkylation of ketone.
(4) YAMAOKA: Sc. & Exp. Rep. No. 144(1941) prep. from undecylalcohol $C_{11}H_{23}OH$.
(5) MIYATA: Ibid., No. 83(1940). From butyrone.
(6) Y. AKITA: Octane Value (1941). Japanese & refer. T. SUWA: Fuel Research Rep. 30.(1935).49.
(7) Benzene and Alcohol or Alkylchloride by Friedel-Crafts reaction, Benzene and ketone in presence of $AlCl_3$, or SO_4H_2. (S.KOMATSU & E. IBUKI)
(8) Synthesized from menthene.
(9) Synthesized from benzene and tert-butyl alcohol.
(10) S. KOMATSU & S.KANEDA: Synthesized from benzene and alcohol.
(11) I. KAGEHIRA (Rep. Imp. Naval Fuel Depot, No. 128(1938);No. 97(1935).
(12) Hydrogenation of benzene, dehydration from cyclo hexanol with $SO_4H_2 \cdot 3H_2O$.(S.K. & K.I.)
(13) S.KOMATSU, S.TANAKA & T. WAIDA: J. Ch. Soc. Japan 54(1933)794.
(14) T.YOKOTA: Exp. & Sc. Rep. 13(1938) 81. 81.
(15) Y. KAGEHIRA: Loc. cit.
(16) I. KAGEHIRA: Unpublished.
(17) S. KIMURA: Hydrogenation of naphthalene.
(18) S. KIMURA: Hydrogenation of sesquiterpene.
(19) S. YUJITA: Synthesized from tetralone and methyl iodide.
(20) KUMAGAI: Isolated from pine resin.

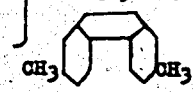
ENCLOSURE (A)

B. THERMAL DECOMPOSITION TEMPERATURE OF HYDROCARBONS

Compound	Formula	Decomposition Temp. (°C) (I)	Reaction Product (II)
Cyclopentane	C_5H_{10}	566	$CH_2=CH_2$, $CH_3CH=CH_2$,
~~Cyclopentene~~	~~C_5H_8~~	~~507~~	
Cyclohexane	C_8H_{12}	550	$(CH_2=CH)_2$, $CH_3CH=CH_2$ C_2H_4, C_6H_6, $C_6H_5CH=CH_2$
Cyclohexene	$C_6H_{1(}$	500	
n-hexane	C_6H_{14}	550	$CH_3CH_2CH=CH_2$, $CH_3CH=CH_2$
2-3-dimethyl butane	C_6H_{14}	535	$(CH_3)_2C=C(CH_3)_2$ $CH_3CH=CH_2$
3-Ethyl Pentane	C_7H_{16}	610	
2-methyl Pentane	C_6H_{14}	41(	
2-2-dimethyl butane	C_6H_{14}	460	
2-2-4-trimethyl pentane	C_8H_{18}	580	$(CH_3)_2C=CH_2$ $CH_3-C(-CH=CH_3)-CH_2$, C_2H_6

(I) S. KOMATSU & K. IBUKI. (unpublished)
(II) S. KATO & Y. SOMENO: Sci. P. I. Phy. Chem. Res. 21(1943)256

ENCLOSURE (A)

Compound	Formula	Decomp. Temp. (°C) (I)	Decomp. Temp. (°C) (II)	Reaction Product
Benzene	C_6H_6	600	750	
Toluene	$C_6H_5CH_3$	600	725	C_6H_6, $(C_6H_5)_2$, $(C_6H_5CH)_2$
Ethyl Benzene	$C_6H_5C_2H_5$	535	721	$C_6H_5CH=CH_2$, $(C_6H_5CH)_2$, C_2H_4, $CH_3CH=CH_2$
Isopropyl Benzene	$C_6H_5CH(CH_3)_2$	506	756	C_6H_6, $C_6H_5CH=CH_2$, $(C_6H_5CH)_2$, $(CH_3)_2CH=CH_2$
Tert. Butyl Benzene	$C_6H_5C(CH_3)_3$	498	720	$C_6H_5CH=CH_2$, C_6H_6, C_2H_6
o-xylene	$C_6H_4(CH_3)_2$	588	703	C_6H_6, $C_6H_5CH_3$ above 700° $CH_2=CHCH=CH_2$
m-xylene	$C_6H_4(CH_3)_2$	633	730	C_6H_6 $(C_6H_5CH)_2$
p-xylene	$C_6H_4(CH_3)_2$		740	C_6H_6 $C_6H_5CH_3$ 
p-methyl Isopropyl Benzene	$C_6H_4(CH_3)C_3H_7$	525	692	
p-diiso Propyl Benzene	$C_6H_4(C_3H_7)_2$	615	730	
n-propyl Benzene	$C_6H_5C_3H_7$	550	650	$C_6H_5CH=CH_2$, $(C_6H_5CH)_2$ C_6H_6, $CH_3CH=CH_2$
n-butyl Benzene	$C_6H_5C_4H_9$	550	700	$C_6H_5CH=CH_2$, $(C_6H_5CH)_2$ C_6H_6, $CH_2=CH-CH=CH_2$
Tetralin	$C_{10}H_{12}$	556	742	
Decalin	$C_{10}H_{18}$	539	746	

(I) S. KOMATSU & E. IBUKI (unpublished)
(II) S. KATO & S. TOMOMURA: Sci. Pap. Inst. Phy. Chem. Res. 21(1942)774.