ENCLOSURE (B) 16

PART V

STUDIES ON HYDROCRACKING OF SUMATRA KEROSENE

by

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SUMMARY

This study was made to determine the optimum boiling range of feed stock for preparation of aviation gasoline from Sumatra Kerosene by hydrocracking. It was found that the fraction boiling from 180-210°C was best for this purpose.

I. INTRODUCTION

In the study on hydrocracking of OMONOGAWA gas oil it was established that the fraction boiling from 160-220°C was best for preparing aviation gasoline. This report covers a similar study on the cracking of narrow fractions of Sumatra Kerosene since a good aviation gasoline could not be obtained by hydrocracking of the total kerosene cut.

Key Research Personnel Working on Project

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II. DETAILED DESCRIPTION

A. Raw Materials

A Sumatra Kerosene cut boiling from 200-250°C was used as the raw material, and this was fractionated into 13 narrow cuts. Properties of the total kerosene and each fraction are given in Table XXXVII(B)16.

B. Test Apparatus and Procedures

The same test apparatus and procedures were used as described in the report "Studies on Hydrocracking of Omonogawa Gas Oil".

The reaction conditions were as follows:

Reaction Pressure ..... 200 Kg/cm^2

Temperature of Preheater ..... 300°C

Temperature of Reaction Chamber ..... 420°C

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H_2 Charged ..... 1 m^3/hr

Oil Charged .....1 lit/hr

Run Period ..... 3-5 hr

Catalyst ..... NiO MoO_3 Active clay (1:3:3) by wt

C. Results

Experimental data are summarized in Tables XXXVII(B)16 to XLII(B)16 and in Figure 7(B)16.

In 14 runs, the yield of product ranged from 70-90 volume%. A part of this variation was due to losses resulting from the intermittent oil gas separation operation. Hydrogen consumption was also higher than expected due to losses.

The content of aromatic hydrocarbons in the feed stocks was generally 10-20 volume%, but after hydrocracking the aromatic content dropped to about 2 volume%. Generally the topped oil became rich in paraffins, as reflected by higher aniline point compared with the feed stock.

III. CONCLUSIONS

In hydrocracking of paraffin rich Sumatra Kerosene, it is considered that the fraction boiling between 180-210°C is the most suitable for producing high octane gasoline.

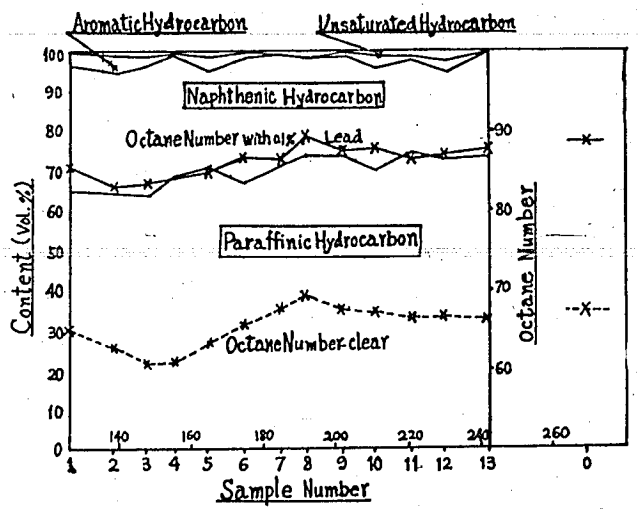

Figure 7(B)16

HYDROCRACKED PRODUCT DATA

		Sample Number													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Yield-(Vol%)				1.0	1.1	1.9	4.7	4.4	4.0	8.0	15.0	17.0	12.0	13.2	12.8
Mean B.P. (°C)		220.2	126.7	139.0	148.0	155.7	164.5	174.5	184.5	192.3	201.7	211.2	221.0	230.4	241.7
d^{20}_{4}		0.8055	0.7491	0.7585	0.7647	0.7702	0.7759	0.7825	0.7808	0.7906	0.7954	0.8002	0.8049	0.8132	0.8239
Fractional Distillation	I.B.P. (°C)	159.0	80.0	78.5	106.0	121.5	132.5	134.0	169.0	182.5	193.0	203.5	214.5	224.5	236.0
	10 %	196.0	96.5	118.5	127.0	138.5	148.5	164.5	177.0	186.0	196.0	206.5	216.5	226.5	238.5
	20 %	204.5	103.5	122.5	132.0	141.5	152.0	166.5	178.0	187.0	197.0	207.0	217.5	227.0	239.0
	30 %	210.0	109.0	126.5	136.5	145.5	156.0	168.5	179.5	188.0	198.0	208.0	218.0	227.5	239.5
	40 %	216.0	113.0	130.5	141.0	149.5	159.0	170.5	181.0	189.0	198.5	209.0	218.5	228.5	240.0
	50 %	220.0	118.3	135.0	146.0	153.5	162.5	172.5	182.5	190.0	199.5	209.5	219.0	229.0	240.5
	60 %	224.0	125.5	139.5	151.0	157.5	165.5	174.5	184.0	191.5	201.0	210.5	220.0	229.5	241.0
	70 %	229.5	134.0	145.0	156.5	162.5	169.5	177.0	186.0	193.0	202.5	211.5	221.5	230.5	242.0
	80 %	238.0	145.5	152.5	163.0	167.0	174.5	180.0	189.5	195.5	205.0	213.5	223.0	232.5	243.0
	90 %	248.0	164.0	163.5	172.0	176.0	187.5	185.0	193.5	199.0	208.5	217.5	225.5	234.5	245.5
	F.B.P.	265.0	204.5	198.0	198.0	200.5	202.0	202.0	214.5	214.5	220.0	227.0	237.5	244.5	254.5
Aniline Point (°C)		65.0	52.8	51.2	51.4	51.6	52.7	54.8	57.6	60.8	63.0	66.0	68.5	69.2	68.7
Constituent Analysis	Unsat. H.C.(Vol%)	1.0	1.0	1.0	0	1.5	1.0	1.0	0.5	0.5	0	1.0	0	0.5	1.0
	Arom. H.C.(Vol%)	14.2	10.0	13.8	16.0	14.7	20.7	18.2	17.9	20.4	15.0	15.2	10.4	17.5	11.8
	Naph. H.C.(Vol%)	18.1	26.7	26.1	23.8	22.3	22.1	18.0	16.0	15.3	17.5	14.1	17.9	11.8	13.9
	Paraff.H.C.(Vol%)	66.7	62.3	59.1	60.2	61.5	56.2	62.8	65.6	63.8	67.5	69.7	71.7	70.2	73.3

Table XXXVII(3)16

PROPERTIES OF RAW MATERIALS

Table XXXVIII(B)16

YIELD AND MATERIAL BALANCE

	Sample Number													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Run Period (Hr.)	5.0	5.0	3.0	4.5	3.5	5.0	3.5	3.5	3.5	5.0	4.5	4.5	4.5	4.5
Oil Changed (l/Hr.)	1.06	0.82	0.80	1.00	1.01	0.98	1.01	1.05	1.12	1.02	1.22	1.00	0.98	1.01
Product (l/Hr.)	0.94	0.78	0.60	0.73	0.80	0.77	0.96	1.01	1.00	0.91	0.84	0.96	0.97	0.97
Yield (Vol%)	88.7	94.6	75.0	73.3	79.2	78.4	94.8	95.8	89.2	89.2	68.6	96.0	100.7	96.0
H_2 Changed (m^3/Hr.)	1.22	1.03	0.98	1.20	1.04	1.14	1.14	1.17	1.16	1.15	1.28	1.16	1.12	1.12
Residual Gas(m^3/Hr)	0.80	0.97	0.81	1.02	0.88	0.87	0.88	0.84	0.86	0.84	0.91	0.82	0.78	0.78
H_2 Consumtion (Wt%)	5.0	1.7	5.4	2.6		5.5	3.7	4.6	3.9	4.3	3.9	4.3	4.1	3.1

		Sample Number													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Mean B.P. of Sample		220	127	139	148	156	165	175	185	192	202	211	221	230	242
d_4^{20}		0.7190	0.7137	0.7220	0.7276	0.7335	0.7307	0.7330	0.7211	0.7146	0.7248	0.7130	0.7239	0.7197	0.7199
Fractional Distillation	I.B.P. (°C)	37.5	39.0	43.5	45.0	52.5	42.0	49.0	37.0	43.5	37.5	35.0	40.5	40.0	40.5
	10 %	59.0	64.5	73.0	78.0	81.5	76.0	78.0	60.0	62.0	63.0	65.5	60.0	59.0	50.5
	20 %	73.5	76.0	86.0	93.5	98.0	95.5	96.5	75.0	75.0	81.5	67.5	75.5	71.5	71.5
	30 %	88.5	88.5	97.5	106.5	112.5	112.0	112.0	92.0	87.0	100.0	82.0	89.0	84.0	82.5
	40 %	103.0	95.5	106.5	118.5	123.5	126.0	140.5	108.5	100.5	119.0	98.0	102.0	94.5	93.5
	50 %	116.0	103.0	114.0	127.0	131.0	136.5	151.5	130.5	115.5	137.5	115.0	116.0	107.5	106.5
	60 %	140.0	110.0	121.5	135.0	138.5	145.0	161.0	154.5	139.0	173.0	133.5	133.5	123.5	123.0
	70 %	163.0	118.0	128.5	142.0	146.5	154.0	165.5	170.0	176.0	186.0	176.0	179.0	147.5	143.0
	80 %	197.0	126.5	136.5	152.5	157.5	161.5	171.0	178.0	184.0	195.0	198.0	203.0	207.0	197.0
	90 %	213.0	149.0	150.5	164.0	167.5	170.0	177.5	185.0	190.0	201.0	206.0	211.0	222.5	230.5
	F.B.P. (°C)	235.5	198.5	192.0	200.5	204.0	194.0	192.5	203.5	201.0	228.5	217.0	232.0	232.0	251.5
	Mean B.P. (°C)	129.6	106.0	113.5	123.9	128.4	128.4	135.8	126.6	124.8	138.3	125.7	131.0	126.2	127.1
Aniline Point (°C)		65.4	60.0	59.2	62.2	61.4	62.7	64.4	65.6	66.0	66.6	66.8	67.4	66.8	65.8
Constituent Analysis	Unsat. H.C. %	1.2	0		0.8	0	0.7	0	0.9	1.8	1.2	1.8	1.3	2.7	1.2
	Arom. H.C. %	1.3	3.6		2.2	1.0	3.9	1.5	0.9	0	0.2	2.4	0.5	2.1	0.1
	Naph. H.C. %	24.1	30.1		32.6	32.8	27.0	26.8	23.2	21.9	23.0	20.8	21.1	19.9	23.8
	Paraff. H.C. %	73.4	66.3		64.4	66.2	68.4	71.7	75.0	76.3	75.6	75.0	77.0	75.3	75.4

Table XXXIX(B)16

PROPERTIES OF TOTAL LIQUID

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Table XL(B)16

ANALYSIS OF RESIDUAL GAS

	Sample Number													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
CO_2 (%)	0	0.1	0.2	0.2		0.1	0.1	0	0.4	0	0	0	0.4	0.1
C_nH_{2n} (%)	0.6	0.6	0.5	0.6		0.8	0.7	0.4	0.6	0.4	0.4	0.3	0.4	0.5
CO (%)	0.3	0.1	0.1	0.1		0.1	0.1	0.8	0	0.2	0.5	0	0	0.3
H_2 (%)	94.7	93.3	67.4	73.8		73.2	93.1	92.1	87.4	93.5	90.5	90.9	93.9	91.1
C_nH_{2n+2} (%)	0.3	1.2	25.1	24.0		23.1	3.3	4.8	3.2	2.3	3.0	6.8	4.1	6.2
n	1.7	1.1	1.4	0.8		0.8	0.6	2.3	1.2	1.2	4.0	1.5	1.4	1.6

ENCLOSURE (B)16

		Sample Number													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Mean B.F. (°C)		220	127	139	148	156	165	175	185	192	202	211	221	230	242
d_4^{20}		0.6930	0.7119	0.7212	0.7204	0.7204	0.7241	0.7166	0.7142	0.6899	0.6882	0.6945	0.6874	0.6931	0.6926
Fractional Distillation	I.B.P. (°C)	45.0	51.0	44.0	51.5	52.5	49.5	50.5	43.0	41.5	45.5	44.5	41.5	41.5	46.0
	10 %	59.5	73.0	75.5	80.0	82.0	70.0	64.5	55.5	55.0	61.5	57.5	58.5	59.0	60.0
	20 %	64.5	81.5	87.5	91.0	92.5	81.0	72.0	62.0	63.0	69.0	66.5	69.5	66.5	68.5
	30 %	71.0	88.5	96.5	100.5	101.0	91.5	81.5	69.0	69.5	76.5	74.0	76.0	74.5	76.5
	40 %	83.5	95.0	103.5	108.0	108.0	102.0	91.0	75.5	75.5	83.0	81.0	84.0	82.0	84.0
	50 %	91.0	99.5	109.5	115.0	114.5	110.5	100.5	83.5	81.0	89.5	88.0	91.5	90.0	92.0
	60 %	98.5	104.5	114.5	121.0	121.0	119.0	109.5	89.5	87.0	96.0	94.5	99.5	98.5	99.0
	70 %	105.0	111.5	120.3	137.0	127.0	126.0	120.0	97.5	93.5	103.0	102.0	107.0	106.0	107.5
	80 %	114.5	118.0	125.5	134.0	134.0	133.5	135.0	107.5	101.0	111.5	110.5	116.0	116.0	116.5
	90 %	126.5	127.0	137.0	142.0	143.0	146.0	149.0	122.5	113.5	123.0	122.5	125.5	122.0	128.0
	97 %	153.5	139.5	147.0	153.0	159.5	161.0	166.5	146.0	134.0	144.5	144.0	138.5	139.5	143.5
	F.B.P.	156.0	150.5	159.5	166.5	164.0	170.5	168.5	158.0	156.0	165.5	148.0	150.5	155.5	152.5
Constituent Analysis	Unsat. H.C. %	1.0	0	0.5	1.0	0	1.0	0	1.5	2.0	1.0	2.0	2.0	3.0	1.5
	Arom. H.C. %	1.9	4.0	5.2	2.9	1.0	3.9	2.0	0	0	0.4	2.7	0.9	2.4	0
	Naph. H.C. %	24.5	31.3	30.1	32.6	31.0	24.9	31.3	25.6	24.8	24.9	25.4	23.3	21.9	25.9
	Paraff. H.C. %	72.6	64.7	64.2	63.5	68.0	70.2	66.7	72.9	73.2	73.7	69.9	73.8	72.2	72.6
Octane Value	Not Leaded	67.0	65.0	62.8	60.5	61.0	63.2	65.5	67.4	69.2	67.4	67.1	66.3	66.6	67.1
	Leaded 0.1 %	88.2	85.2	83.4	83.4		84.9	86.6	86.4	89.5	87.4	87.8	86.4	86.8	87.6
Yield of Aviation Gasoline %		62.0	90.5	89.0	79.0	76.0	65.0	49.0	58.0	62.0	43.0	64.0	62.0	72.0	73.0

Table XLI(B)16

PROPERTIES OF AVIATION GASOLINE

Table XLII(B)16

PROPERTIES OF TOPPED OIL

		Sample Number													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
d_4^{20}		0.7789	0.7618	0.7752	0.7664	0.7731	0.7641	0.7664	0.7685	0.7712	0.7792	0.7789	0.7814	0.7840	0.7880
Fractional Distillation	I.B.P. (°C)	158.0	157.0	153.5	149.0	150.0	147.5	152.0	162.0	160.0	167.0	165.0	175.0	173.0	166.5
	10 % (°C)	173.0	163.0	158.5	155.0	158.0	153.5	159.0	168.0	169.5	179.0	178.5	192.5	190.0	192.0
	50 % (°C)	198.0	173.5	168.0	164.0	165.5	162.5	169.5	176.0	181.0	192.5	197.5	210.0	217.0	225.5
	90 % (°C)	228.5	298.5	197.5	183.5	187.0	179.0	180.5	189.5	193.6	205.0	210.5	220.5	228.0	239.0
	F.B.P. (°C)	260.0	244.0	226.5	224.0	243.5	206.0	192.0	206.0	203.0	226.5	220.0	238.0	237.0	247.0
Aniline Point (°C)		72.4	66.8	64.3	67.0	65.8	65.6	67.7	69.8	71.0	70.7	73.2	75.6	76.0	75.8
Constituent Analysis	Unsat. H.C. %	1.5	0		0	0	0	0	0	1.5	1.5	1.5	0	2.0	2.0
	Arom. H.C. %	0	0		0	1.0	4.0	1.0	2.0	0	0	1.9	0	0	0.4
	Naph. H.C. %	23.1	19.6		32.6	37.9	28.1	22.4	19.9	17.1	20.9	12.6	17.3	15.3	14.1
	Paraff. H.C. %	75.4	80.4		67.4	61.1	67.9	76.6	78.1	81.4	77.6	84.0	82.7	82.7	83.5

Fractional Distillation