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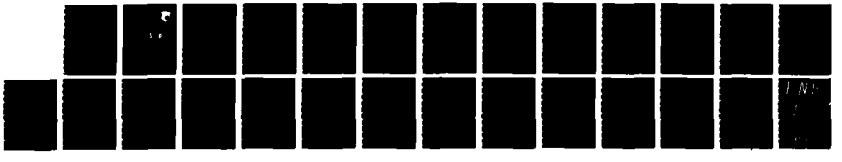

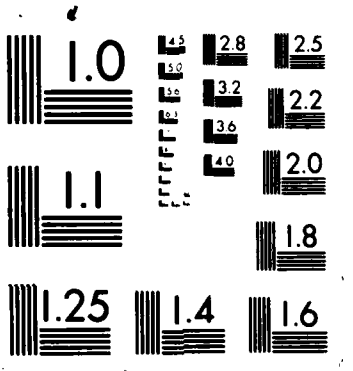
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AFWAL-TR-87-2001

PRODUCTION OF JET FUEL SAMPLES FROM LIGHT CYCLE OIL AND LIGHT PYROLYSIS OIL

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MARCH 1987

Final Report for Period November 1985-March 1986

AERO PROPULSION LABORATORY
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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This report has been reviewed and is approved for publication.

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Work under this program was directed toward production of test fuel samples from light cycle oil (LCO) and light pyrolysis fuel oil (LPFO) feedstocks. The processing sequence used to produce these samples involved hydrodesulfurization of LCO followed by high-pressure batch hydrogenation over sulfided nickel/molybdenum catalyst to achieve a desired aromatic content of 20, 30 and 45 percent. LPFO was hydrostabilized over nickel on silica/alumina catalyst followed by high-pressure batch hydrogenation over sulfided nickel/molybdenum catalyst to achieve an aromatic content of 30 percent. Four test samples in excess of 2000 gallons were produced and delivered in bulk and in [illegible] specified.

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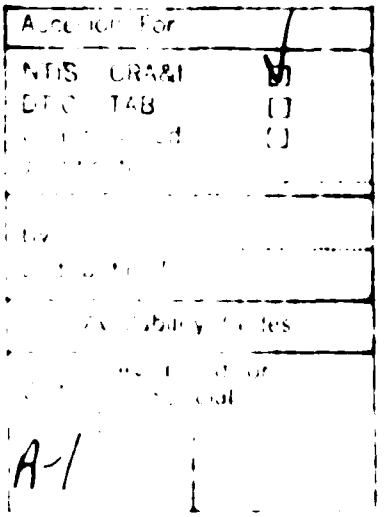
FOREWORD

This report was prepared by the Applied Research and Development Department of Sun Refining and Marketing Company under the auspices of Contract DLA600-85-C-0497 administered by the Defense Fuel Supply Center, Cameron Station, Virginia and Contract F33615-83-C-2352 administered by the Aero Propulsion Laboratory, Fuels and Lubrication Division, Air Force Wright Aeronautical Laboratories, Wright Patterson AFB OH 45433-6563. Mr Eddie J. French (DFSC) and Capt W. E. Harrison (POSF) were project engineers.

This final technical report details the work involved in the pilot plant production of sample quantities of high-density naphthenic fuels by hydrogenation of Light Cycle Oil (LCO) and Light Pyrolysis Fuel Oil (LPFO).

Dr Lewis W. Hall, Jr., was Program Manager



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1.0 INTRODUCTION

Light cycle oil (LCO) and light pyrolysis fuel oil (LPFO) are highly aromatic refinery streams potentially suitable for production of high-naphthenic content fuels by hydrogenation. LCO is a by-product from catalytic cracking of heavier petroleum fractions boiling up to 1050°F and is normally recovered as a fraction in the boiling range of 275°F to 700°F representing approximately 15 to 25 volume percent of the charge to the cracking unit.

LPFO is a by-product of the manufacture of ethylene by steam cracking of gas oil and heavier stocks. LPFO is also recovered as a fraction in the 300°F to 700°F boiling range.

Fuels produced by hydrogenation of both LCO and LPFO are of interest because of their high-naphthenic content and because the resultant fuels closely approximate the boiling range (400°F-572°F) of JP-8 type fuel. The high concentration of naphthenic hydrocarbons resulting from hydrogenation of the highly aromatic stock provides increased density and volumetric heating value compared to other aviation turbine fuels which contain higher concentrations of paraffinic hydrocarbons contributing to lower density and lower volumetric heating value.

This report documents the work carried out by Sun Refining & Marketing Co. to produce four test fuel samples of approximately 2000 gallons each by hydrogenation of LCO and LPFO chargestocks. Three test fuel samples each having aromatic contents within the required range of 20±3, 30±4 and 45±5 percent were produced from LCO stocks. A fourth test fuel was produced by hydrogenation of LPFO to an aromatic content within the required range of 30±4 percent. Additional properties required for all test fuel samples were a freezing point of -35°F maximum and a boiling range of 310°F to 620°F.

2.0 FEEDSTOCKS

The feedstocks used for sample production were Light Cycle Oil (LCO) obtained from Texaco's Delaware City, Delaware, Refinery and Light Pyrolysis Fuel Oil (LPFO) obtained from Corpus Christi Petrochemical Company, Corpus Christi, Texas. Table 1 contains characterization data for each feedstock as received from the refinery.

2.1 LCO Chargestock

In selecting a suitable LCO chargestock for test fuel sample preparation, primary consideration was given to pour point and aromatic content since these properties affect freezing point and naphthenic content of the finished fuel. A great many LCO samples surveyed as potential chargestock for this work were found to have pour points in the range of 15°F to -20°F. Hydrogenation of these stocks to aromatic levels in the range of 20-30 percent did not reduce pour point to any significant degree and thus precluded their use for production of fuel samples meeting a -35°F freezing point requirement.

TABLE 1 Feedstock Characterization

FEEDSTOCK SAMPLE ID		LIGHT CYCLE OIL DRS 400	LIGHT CYCLE OIL DRS500	LIGHT PYROLYSIS OIL DRS 600
PROPERTY	ASTM METHOD			
API Gravity	D1298	19.0	15.0	10.3
SP GR 60/60°F		0.9402	0.9660	0.9981
Freeze Point, °F	D2386	-34	-30	-35
Viscosity, cSt	D445			
100°F		1.87	1.945	0.896
210°F		0.85	0.945	0.896
Distillation	D1160			
IBP		334	372	376
5%		376	413	428
10%		390	429	442
30%		435	463	460
50%		485	497	469
70%		528	539	484
90%		623	616	512
95%		676	651	544
EP		-	-	578
Flash Point, °F	D56	-	177	190
Carbon, wt.%		88.73	89.12	92.1
Hydrogen, wt.%		9.45	9.37	7.7
Nitrogen, ppm	D229	262	330	25.2
Sulfur, ppm	D2622	23950	20000	887
Aromatics, wt.%	D2549			
Mono		13.4	18.6	17.9
Di		53.1	53.9	79.2
Tri		6.4	6.0	1.0
Tetra		0.3	0.4	0.0
Penta		0.1	0.3	0.0
Thiopheno		16.2	11.2	0.2
Other		-	1.1	0.2
Total		89.5	91.5	98.3
Saturates, wt.%	D2549			
Paraffins		6.8	4.3	0.7
1 Ring		0.7	0.8	0.3
2 Ring		0.8	0.9	0.3
3 Ring		0.9	1.2	0.2
Other		1.3	1.3	0.2
Total		10.5	8.5	1.7

In general the hydrocarbon composition of LCO will be dependent upon the type of crude being refined (i.e., paraffinic, naphthenic or aromatic) and the severity of operations of the FCC unit. The presence of paraffinic hydrocarbons in LCO appears to contribute to high-pour points such that chargestocks suitable for hydrogenation without additional processing to remove or alter paraffin content will be limited to LCO derived primarily from naphthenic or aromatic type crudes. This requirement seriously mitigates the volumes of LCO suitable for hydrogenation directly to aviation turbine fuel without additional processing to remove paraffins prior to hydrogenation. Additional processing of high-paraffin content stocks would involve solvent or catalytic dewaxing to achieve acceptable freezing points of -35°F or lower in the finished fuel.

Two batches of approximately 4000 gallons each of LCO were obtained from Texaco's Delaware City Delaware Refinery. The first batch listed in Table 1 as sample DRS-400 was obtained in June 1985 and used to prepare the test fuels required under contract DLA600-85-C-0497. The second batch (DRS500) of LCO was taken in November, 1985 and used to prepare additional quantities of test fuel as required under contract F33615-83-C-2352. Both batches of LCO were loaded directly from the FCC unit into tank wagons and transported to Marcus Hook. In order to obtain low-pour point LCO, i.e., LCO with a pour point of -30°F or below, it was necessary to obtain chargestock at a time when the refinery was running Venezuelian crude which is characteristically naphthenic.

Slight differences in the inspection data (Table 1) of the LCO stocks are attributed to the narrower boiling range of DRS500 which is consistent with the lower API gravity and slightly higher aromatic content of this stock. Both stocks contained approximately 2-percent sulfur which was removed via a first-stage hydrogenation prior to saturation of the aromatics.

2.2 LPFO Chargestock

Laboratory scale hydrogenations of LPFO stocks from Corpus Christi Petrochemical Co. and from Exxon Chemical Co. were carried out to assess the potential of each of these stocks for test fuel production. Both LPFO stocks were hydrogenated without difficulty and proved suitable for sample production.

Inspection and analysis of Exxon LPFO sample and hydrogenated product are listed in Table 2.

Table 2 Properties of Exxon LPFO and Hydrogenated Product

Properties	LPFO	Hydrogenated Product
Spec. Grav., 60/60°F	0.9735	0.8728
Distillation, D-2887		
IBP	292	208
10	376	334
50	464	396
90	563	496
EP	686	678
Sulfur, ppm	2000	2
Aromatics, Vol.%	100	24
Pour Point, °F	NA	Below -50

As obtained the Exxon LPFO exhibited a lower initial boiling point than would be desirable to achieve a desired 310°F initial boiling point for a test fuel sample. Discussion with Exxon operating personnel indicated that the boiling range of this material could be adjusted to a more desirable range once that were established. However, at the time chargestock was needed for sample production, Exxon LPFO was unavailable due to revamping of plant loading facilities.

LPFO chargestock for sample production was obtained from Corpus Christi Petrochemical Co. Physical property data for this stock are tabulated in Table 1.

3.0 HYDROSTABILIZATION OF CHARGESTOCKS

Both LCO and LPFO chargestocks were processed through a mild first-stage hydrogenation to reduce the sulfur content of LCO and in the case of LPFO to remove any olefins and diolefins present as precursors to polymer formation that might occur under the more severe conditions required for aromatic saturation.

Table 3 lists properties of the hydrotreated feedstocks as produced and subsequently used for production of the required test fuel samples. One drum each (DRS460, DRS550, DRS601) of hydrostabilized chargestock listed in Table 3 was sparged carefully with nitrogen to remove residual hydrogen sulfide and light ends. These drums were delivered to WPAFB as specified under contract.

TABLE 3 Hydrostabilized Feedstocks

SAMPLE ID		LIGHT CYCLE OIL		LIGHT PYROLYSIS OIL
		DRS 460	DRS 550	DRS 601
PROPERTY	ASTM METHOD			
API Gravity	D1298	27.0	23.2	-
SP GR 60/60		0.8927	0.9153	0.9910
Freeze Point, °F		-37	-37	-58
Distillation, °F	D86			
IPB		321	364	386
5%		363	400	432
10%		374	414	433
30%		403	438	450
50%		433	464	564
70%		473	496	481
90%		538	560	514
95%		587	596	538
EP		608	654	568
Flash Point, °F	D-56	140	161	180
Carbon, wt%		88.98	89.34	91.92
Hydrogen, wt%		11.10	10.84	8.19
Nitrogen, ppm		0.15	5.5	16.4
Sulfur, ppm		864	1540	546
Aromatics, wt%	D2549			
Mono		11.0	23.8	15.1
Di		72.1	61.5	74.7
Tri		0.7	2.3	0.8
Tetra		0.1	0.0	0.0
Penta		0.0	0.0	0.0
Thiophene		1.3	0.0	0.4
Other		0.0	0.0	0.0
Total		85.2	87.6	91.0
Saturates, wt%	D25			
Paraffins		7.1	4.9	-
1 Ring		1.4	1.2	-
2 Ring		3.1	2.3	-
3 Ring		2.1	2.0	-
Other		1.0	2.0	-
Total		14.8	12.4	-

3.1 Hydrodesulfurization of LCO Stock

The primary objective of a first-stage hydrogenation of LCO is to reduce sulfur content to a level in the range of 1500 ppm. In batch hydrogenation the release of hydrogen sulfide and subsequent accumulation in the reactor tends to reduce hydrogen partial pressure significantly slowing the rate of hydrogenation. This situation was easily overcome by purging the vapor space during the course of hydrogenation.

The first stage hydrodesulfurization of LCO was accomplished over Ketjen KF840, nickel/molybdenum catalyst. This catalyst was used for all-first and second-stage hydrogenations of LCO and for the second-stage hydrogenation of LPFO.

Desulfurization of LCO stocks was carried out at 610°F and 2500-psig hydrogen pressure. Reaction times required to reduce sulfur content of the LCO charge to below 2000 ppm were nominally 10 hours. The reactor was purged twice during this period and the off-gas containing large amounts of hydrogen sulfide passed through a scrubber containing 15-percent caustic in water.

Working reactor volume was varied during the first series of runs but appeared to be optimum in terms of reaction rate at 400-425 gallons. The volume of catalyst contained in the reactor was approximately 25 gallons resulting in an oil to catalyst ratio of approximately 16:1.

3.2 Hydrostabilization of LPFO Stock

The objective of the first-stage hydrogenation of LPFO stock was the removal of any olefins and/or diolefins that might be polymerized under more severe hydrogenation conditions. The formation of polymeric material is undesirable because it may affect catalyst life and/or activity or because it would be deleterious to the properties of the finished fuel samples if not removed by additional processing.

Hydrostabilization of the LPFO stock was accomplished in a single large batch under relatively mild conditions as follows:

Feedstock	=	3250 gallons LPFO
Catalyst	=	600 lbs (2.2 wt.%) Harshaw Nickel Ni-5132P
Temperature	=	275°F
Pressure	=	75 psig H_2
Run Time	=	20 hours

Hydrogen uptake under these conditions initiated at about 135°F and 10 psig H_2. Both temperature and pressure were increased over 20 hours to maximums of 275°F and 75 psig respectively at which time hydrogen uptake ceased.

4.0 HYDROGENATION OF STABILIZED STOCKS

The required test fuel samples were produced by further hydrogenation of the stabilized stocks to the target aromatic levels of 20±3, 30±4 and 45±5 percent for LCO derived fuel samples and 30±4-percent aromatics for the LPFO derived fuel sample.

4.1 Hydrogenation Conditions

Second-stage hydrogenation of LCO and LPFO was carried out over the sulfided Ketjen KF840 catalyst at 630°F and 2800-psig hydrogen pressure.

The progress of aromatics conversion was conveniently monitored by following the change in API gravity of the reactor contents with time. This in turn was correlated with aromatics concentration as determined by FIA analysis as shown in Figure 1 for two-LCO chargestocks. In the region of 20 to 45-percent aromatics, a linear relation between API gravity and aromatic content appears valid. However, over the entire range of aromatics, the relationship to API gravity appears best represented by a binomial function of the form ax^2+bx+c.

The first- and second-hydrogenation stages of LCO were carried out successively using a single batch of catalyst which remained in the reactor throughout sample production. Following the LCO runs, the catalyst was flushed with hydrostabilized LPFO and used to hydrogenate the required batches of LPFO.

4.2 Catalyst Preparation

The catalyst was vacuum dried for 24 hours at 185°F, charged to the reactor and sulfided with carbon disulfide at 600°F, 1000-psig H_2 for 5 hours per vendor recommendations. After sulfiding, a break-in run was made at 630°F, 1200-psig H_2 with fresh charge to properly age the catalyst. The resulting catalyst was used for all successive batch hydrogenations and did not appear to lose activity during the period of use.

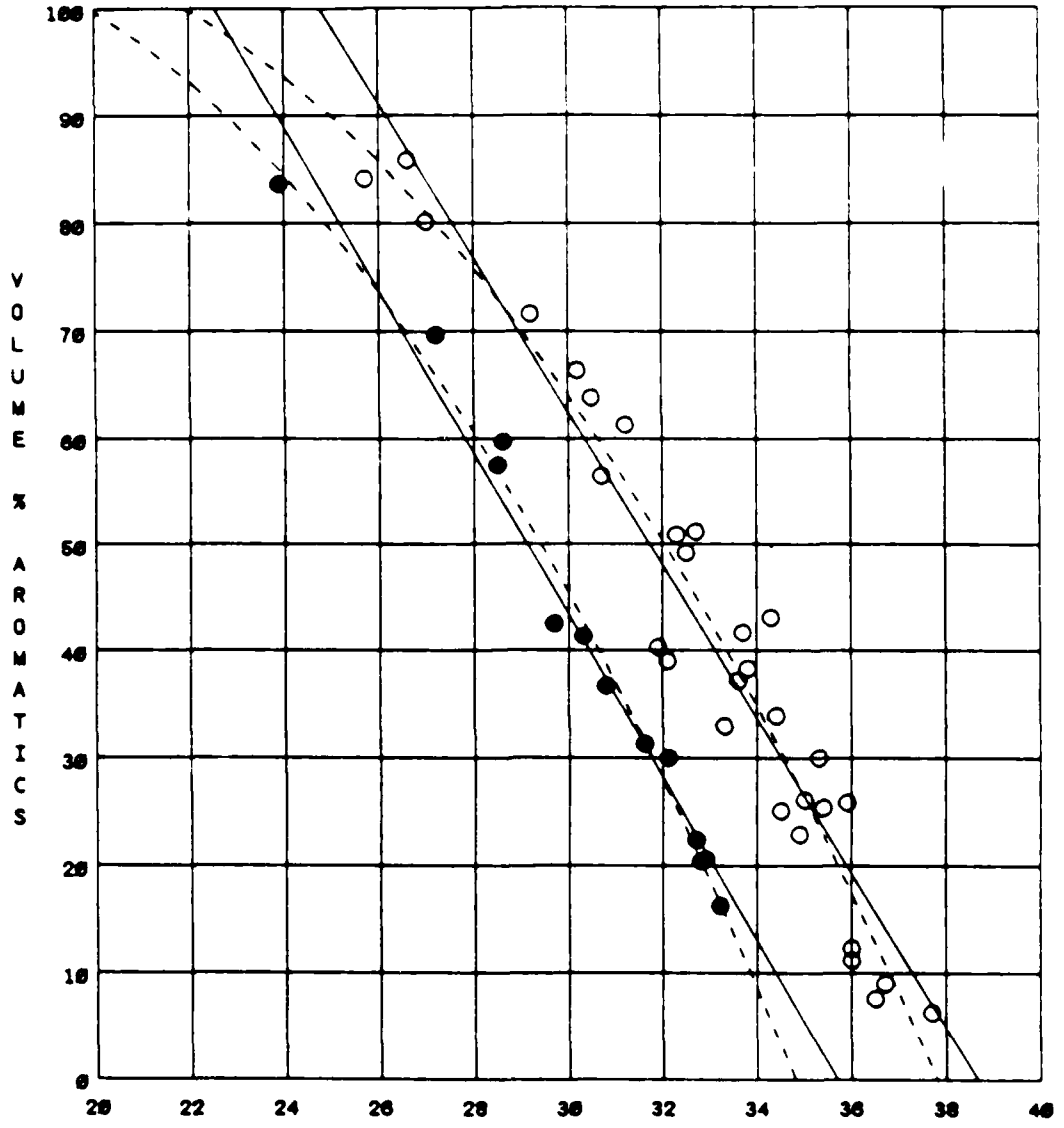

FIGURE 1
AROMATICS (FIA) VS API GRAVITY

4.3 Hydrogen Consumption

Table 4 provides data on hydrogen consumption and apparent reaction times to achieve the desired aromatic levels. Both of these parameters are obscured by the fact the reactor was purged at various intervals to maintain high partial pressure of hydrogen and cooled at various times in order to sample the reactor contents. Thus, hydrogen uptake could not be measured directly and reaction times are probably not indicative of rates of hydrogenation that could be expected under normal continuous unit operating conditions.

The values for hydrogen consumption given in Table 4 are calculated from the elemental analysis of the charge and hydrogenated products. Total hydrogen consumption for two-stage hydrogenation is in the range of 1500 to 3000 SCF/bbl for both LCO and LPFO.

5.0 TEST FUEL SAMPLES

Table 5 provides a tabulation of the properties of the four test fuel samples produced under this program. In all cases the aromatic content of each sample was within the desired range as were the freezing point and distillation. The volumetric heating values listed in Table 5 are generally higher than typical values for JP-4 and JP-8 by 11 and 5 percent for LCO derived fuels and by 15 and 8 percent for LPFO derived fuel.

The physical property data compiled in Table 5 were obtained on final composite blends made up of several 350-400-gallon batch hydrogenation required to produce the desired quantity (2000 gallons) of each test fuel. Fuel from each hydrogenation batch was combined in a 5000-gallon vessel and thoroughly mixed under nitrogen sparging to remove any residual hydrogen sulfide and light ends. When thoroughly mixed corrosion inhibitor, DuPont DCI-4A, was added to each finished composite test fuel sample at the rate of 6 lbs/1000 bbl along with Dibutyl *para* cresol (DBPC) antioxidant at the rate of 7 lbs/1000 bbl.

Table 6 provides a summary of test fuels shipped and the destination. As denoted by an asterisk, approximately 1800 gallons of each fuel sample was shipped in bulk via a government owned tank wagon. Drum shipments were made to United Technologies, East Hartford, Connecticut and to Purdue University, West Lafayette, Indiana.

TABLE 4 Hydrogen Consumption

Charge	Aromatic Content %, FIA	H_2 Consumption SCFBbl	Time, Hr
LCO	Desulfurization	961	10
LCO	20%	1184	72
LCO	30%	1036	30
LCO	45%	684	24
LPFO	Hydrostabilization	331	20
LPFO	30%	2527	30

TABLE 5 Properties of Test Fuels

PROPERTY	ASTM METHOD	DRS 556 986 POSF 2382)	DRS 580 (86 POSF-2398)	DRS 583 (86 POSF 2414)	DRS 632 (86 POSF 2429)
Feed Stock, Arom	-	LCO, 20±3	LCO, 30±4	LCO, 45±5	LPFO, 30±4
Quantity, gal		2137	2137	2084	2120
Aromatics, Vol %	D1319	21 7	30.1	41.2	32.2
API Gravity		34 0	32.3	30.6	26.8
Specific Gravity		0 8557	0.8636	0.8732	0.8940
Freezing Point, °F	D2386	-38	-40	-45	-70
Distillation	D86				
IBP		330	326	294	366
5%		356	357	357	38
10%		370	372	372	396
30%		401	399	400	410
50%		428	428	427	422
70%		461	462	463	441
90%		527	532	535	486
95%		574	578	580	540
EP		606	611	607	604
Viscosity, cSt	D445				
100°F		1 8	1.83	1.81	2.08
212°F		0 86	0.86	0.84	0.946
Flash Point, °F	D56	124	128	133	143
Carbon, wt %		86 96	87.32	87.86	87.73
Hydrogen, wt %		13 00	12.73	12.12	12.34
Nitrogen, ppm		0 26	0.11	3.76	0.17
Sulfur, ppm		27 5	20.5	246.7	0.99
Heating Value	D240				
BTU/lb		18,413	18,317	18,185	18,234
BTU/gal		130,805	131,311	131,822	135,339
Percent increase over					
JP-8 Fuel		4 3	4 7	5 1	7.5
JP 4 Fuel		9 5	9 9	10 2	12.5

TABLE 6 Quantities of Fuel Samples Shipped

FUEL	DESCRIPTION	DESTINATION	QUANTITY, GALLONS DLA600-85-C-0497	F33615-83-C-2352
DRS 556 (86-POSF-2383)	20% LCO	WPAFB	880•	1027•
		WPAFB	-	50
		United Technologies	150	-
		Purdue	30	-
		Total	1060	1077
DRS 580 (86-POSF-2398)	30% LCO	WPAFB	880•	1027•
		WPAFB	-	50
		United Technologies	150	-
		Purdue	30	-
		Total	1060	1077
DRS 583 (86 POSF 2414)	45% LCO	WPAFB	880•	974•
		WPAFB		50
		United Technologies	150	-
		Purdue	30	-
		Total	1060	1024
DRS 632 (86 POSF 2429)	30% LPFO	WPAFB	-	1840•
		WPAFB	-	100
		United Technologies	-	150
		Purdue		30
		Total		2120
DRS 460 (85 POSF 2306)	Hydro-stabilized LCO	WPAFB	50	-
DRS 550 (86 POSF 2391)	"	WPAFB	50	-
DRS 601 (86 POSF 2440)	Hydro-stabilized LPFO	WPAFB	-	50

•Shipped in Bulk via tank wagon

6.0 HYDROCARBON TYPE ANALYSIS

In view of the fact that the heating values, as shown in Table 5, for the 30% aromatic fuels from LCO and LPFO are significantly different, further analysis of the hydrocarbon types in each fuel was carried out in an effort to learn more about the composition of each of these fuels. Accordingly each fuel was distilled into fractions representing approximately ten volume percent of the sample. The hydrocarbon types present in each fraction were determined and are tabulated in Table 7 for fractions from the 30% aromatic LCO fuel (DRS 580) and in Table 8 for fractions from the 30% aromatic LPFO fuel (DRS 632). Each table also contains data on the boiling range of each fraction, the specific gravity and the hydrogen content.

Hydrocarbon types present in fractions 1-7 were determined by mass spectrometry as described by Lawery and Paulson (Anal. Chem. 34, 538, 1962) for petroleum fractions boiling up to 450°F. The higher boiling fractions i.e., 8-10 were analyzed by mass spectrometry according to ASTM 2786 which is useful for petroleum fractions boiling above 400°F.

With reference to Tables 7 and 8, it appears that the major difference between LCO and LPFO fuels, with respect to hydrocarbon type, is the lower paraffin content of the LPFO fuel. This results in a higher naphthenic content since both fuels have been hydrogenated to nearly identical aromatic levels and contributes significantly to the increased specific gravity (density) of the LPFO fuel resulting in a higher volumetric heating value.

Although the aromatic content of both fuel samples is similar, the distribution of aromatics within the distillate fractions of LCO and LPFO derived fuels is significantly different as shown in Figure 2. In cuts 1-5 the aromatics remaining after hydrogenation are predominately C_9-C_{13} alkyl benzenes

Examination of the naphthenic fraction of cuts 1-5 reveals a high ratio of monocycloparaffins to dicycloparaffins in the hydrogenated LCO and the opposite ratio in the hydrogenated LPFO as shown in Table 9 indicating that the lower boiling aromatics in LCO are predominately alkylbenzenes whereas the aromatic content of LPFO is primarily alkylnaphthalenes which on hydrogenation produce higher density tetralin and decalin derivatives

With the exception of paraffin content there appears to be little discernible difference in the hydrocarbon types present in cuts 6-10 for each fuel

TABLE 7 LCO Distillation Cuts
DRS 580

CUT	BP DEG F	SP GR 60/60	% HYDROGEN	FIA AROM	LC AROM	PNOA AROM	PNOA PARA	PNOA NAP
1	204-362	0.8044	13.460	19.80	24.40	21.6	4.40	72.20
2	362-375	0.8347	13.120	36.50	31.40	26.8	9.60	63.20
3	375-389	0.8486	12.930	24.20	30.80	24.6	9.90	65.00
4	389-418	0.8583	12.930	22.50	28.40	23.1	10.90	66.00
5	418-434	0.8609	12.870	28.10	27.10	19.2	9.90	70.90
6	434-448	0.8718	12.670	25.60	30.10	19.6	8.20	72.20
7	448-477	0.8766	12.710	38.00	44.70	54.6	8.10	37.20
8	477-512	0.8927	12.540	50.40	50.20	46.2	10.70	43.00
9	512-566	0.8954	12.540	53.20	43.40	34.2	14.60	51.10
10	566+	0.9014	12.680	100.00	38.70	28.1	20.40	51.48
MEAN		0.8645	12.845	39.83	34.92	29.8	10.78	59.22
DRS 580		0.8636	12.730	30.10	31.10			

TABLE 8 LCO Distillation Cuts
DRS 632

CUT	BP DEG F	SP GR 60/60	% HYDROGEN	FIA AROM	LC AROM	PNOA AROM	PNOA PARA	PNOA NAP
1	196-375	0.8586	13.130	10.20	10.10	11.00	0.00	89.00
2	365-395	0.8758	13.060	5.10	5.70	6.50	0.00	93.50
3	395-403	0.8797	12.790	12.20	13.80	12.50	0.20	87.10
4	403-420	0.8811	12.820	13.30	15.40	13.40	0.50	86.10
5	420-432	0.8821	12.830	16.80	16.30	13.50	1.20	85.30
6	432-444	0.8932	12.420	31.50	26.90	22.80	1.10	76.10
7	444-457	0.9071	12.010	44.60	46.30	61.30	0.70	38.00
8	457-486	0.9146	11.690	56.70	53.30	58.90	0.70	41.00
9	486-511	0.9268	11.300	63.40	64.90	59.00	2.30	38.70
10	511+	0.9272	12.040	100.00	46.90	41.60	9.40	49.10
MEAN		0.8946	12.409	35.38	29.96	30.05	1.61	68.39
DRS 632		0.8940	12.340	32.20	30.50			

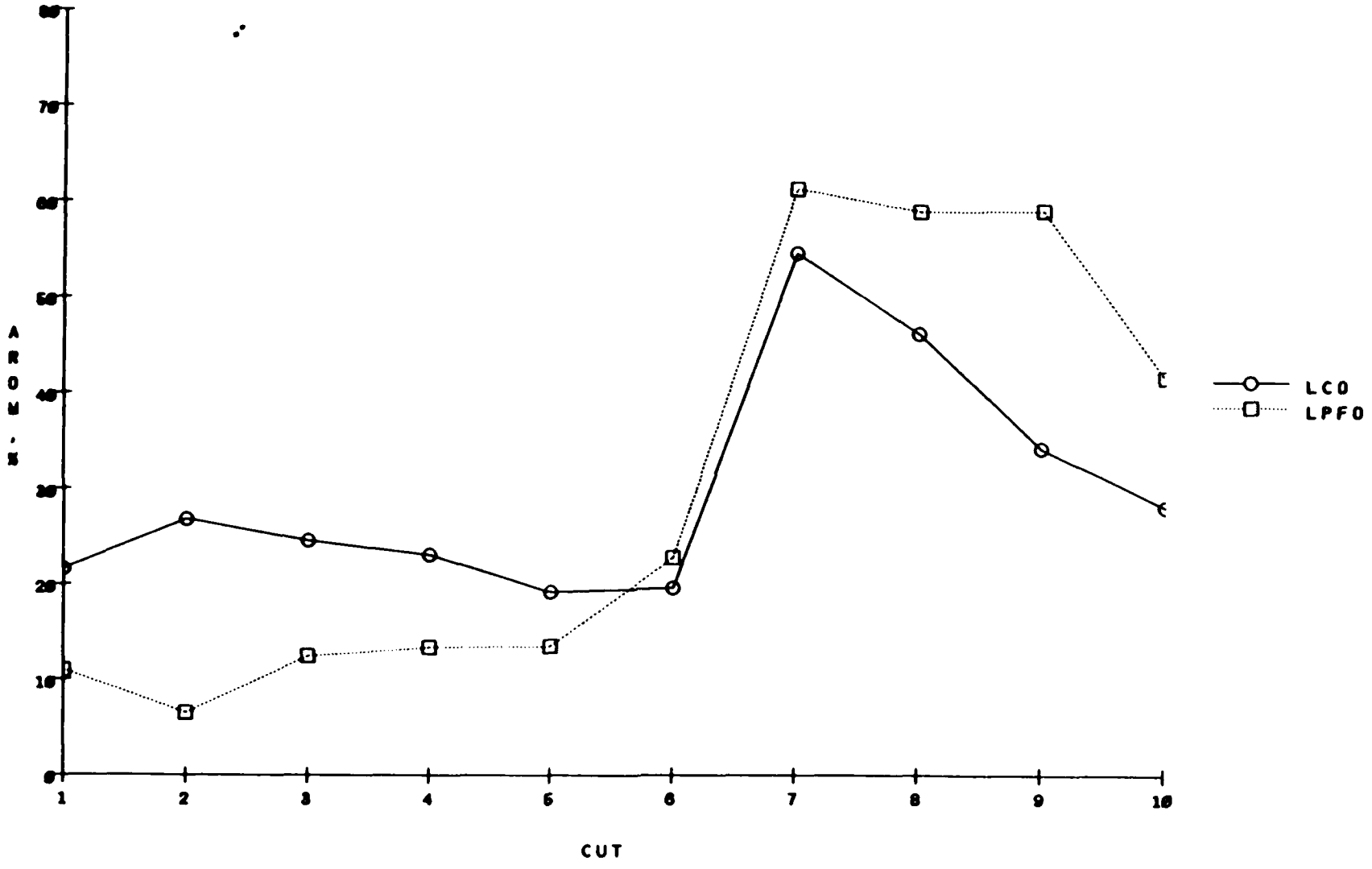

Figure 2
Aromatic Content of LCO and LPFO
Distillation Cuts

TABLE 9 Distribution of Mono- and Dicycloparaffins in Distillation Cuts 1-5

	Monocycloparaffins		Dicycloparaffins	
	LCO	LPFO	LCO	LPFO
Cut 1	69.1	25.9	2.9	63.1
Cut 2	33.9	2.1	29.3	91.4
Cut 3	22.4	4.9	42.6	82.4
Cut 4	15.4	6.4	50.6	79.6
Cut 5	19.3	9.5	51.3	75.2

7.0 CONCLUSIONS

Light Cycle Oil (LCO) was hydrogenated over a sulfided nickel/molybdenum catalyst to produce 2000 gallon samples of test fuels containing 20-, 30-, and 45-percent aromatics. Processing was carried out in two stages involving hydrodesulfurization followed by further hydrogenation to achieve the desired aromatic levels. The test fuels produced from LCO charge stock were within the JP-8 boiling range, exhibited freezing points of -38°F or below and showed volumetric heating values in the range of 130,800 to 131,800 Btu/gallon.

In order to achieve freezing points of -35°F and below it is necessary to select LCO feedstocks for hydrogenation which are derived from naphthenic crudes.

Light Pyrolysis Fuel Oil (LPFO) was hydrostabilized under mild conditions over supported nickel catalyst followed by saturation of the aromatics over sulfided nickel/molybdenum catalyst to produce a 2000-gallon sample of test fuel containing approximately 30-percent aromatics. This fuel sample was of higher density than the LCO derived fuel at the same aromatic level and showed a volumetric heating value of 135,300 Btu/gallon.

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