ESSO PRODUCTION RESEARCH COMPANY

GEOCHEMICAL ANALYSIS OF SAMPLES OF HYDROCARBONS FROM THE ESSO 25/11-1 WELL, NORWAY

R. E. Metter
J. N. Mercer

Basin Geology Division

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EPR67-ES99

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by

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SUMMARY

Crude oil samples from 5758 and 5829 ft. were analyzed by Humble's Refinery Laboratory and found to be naphthenic-aromatic crudes particularly suitable for a fuel products plant. They resemble the Velasquez crude from Colombia.

Hydrocarbons from various sand zones in the interval 5685-5829 ft. in the 25/11-1 well were analyzed by various geochemical techniques and found to be similar in composition. They are interpreted to be genetically related. A shale from approximately 5722 feet contains hydrocarbons that by some criteria correlate with the oils. However, there are differences in some correlation parameters that suggest this particular shale does not represent the entire source section of the hydrocarbons, even though it is genetically related to the source interval.

This information will chiefly provide background data for further correlation studies in the Norway offshore area.

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INTRODUCTION

This report summarizes the results of organic geochemical analyses of various hydrocarbon samples from the interval 5685-5829 ft. in the Esso 25/11-1 well. These samples include:

4 fluid samples, retorted by the Baroid engineer at the wellsite, from core plugs taken at 5685, 5705, 5707 and 5715 ft.

1 oil-saturated sandstone core from 5715 ft.

1 shale core from the interval 5714-5728 ft.

2 F. I. T. crude oil samples: one from 5758 ft. and the other from 5829 ft.

Figure 1 shows the sample locations with reference to a Schlumberger induction log resistivity curve.

A few additional samples were received from this interval, but it was decided that the interval is adequately represented by those items listed above, and these are all that were analyzed.

This study provides information that characterizes the oil in the 25/11-1 well--both for economic evaluations and for possible correlation studies with other oil samples or with possible source rocks.

Correspondence from Esso Exploration Norway, Inc. discussing various of these samples and requesting their analysis includes a June 6, 1967 letter by R. E. Anderson and two letters of June 19 and June 28 by L. Weiss. The June 6 letter requested that the retort and core samples be given "as complete an analysis as possible." In a letter of July 17, 1967 by Mr. A. J. Caan of the North Sea Group, several types of analyses were suggested, including gasoline, carbon isotope, high mass molecular and Hempel distillation, among others.

At present, we are not equipped to make Hempel distillation analyses at EPR, but Humble's Refinery Laboratory at Baytown, Texas routinely runs crude oil assays for economic assessment of crudes and these are comparable to the Hempel technique. Therefore, the two crude oil samples were sent to the Refinery Laboratory for analysis. These results were transmitted to the North Sea Group and to Esso Exploration Norway in our letter of August 15, 1967. Copies of these data sheets are also included at the end of this report. Sample 54051-A is the F. I. T. sample from 5758 ft., and 54051-B is from 5829 ft.

Mr. Robert J. Michael of Humble's Headquarters organization examined the distillation data briefly and made several verbal comments on the oils, as follows:

A search of the files on crude oil analyses showed that the oils were similar to oil from the

Velasquez field in Colombia.* The oils are naphthenic-aromatic crudes that are particularly suitable for feed in a fuel products plant but would not be suitable for jet fuel, lube oil or asphalt. The $650^{\circ}+$ cut would produce a low-sulfur fuel oil (1.0-1.1% sulfur) which would be very desirable for use in Europe or the eastern United States, in view of sulfur-control laws in both areas. In Colombia this crude brings $2.00 - 2.15 per barrel. In Europe it would probably bring up to $2.40.

The analyses run at EPR and discussed in this report are oriented toward characterizing the hydrocarbon samples for correlation studies. Techniques of carbon isotope and molecular identifications that have been found helpful in other areas in distinguishing groups of genetically related oils were used.

Charges for this work have been billed to Esso Exploration via our Job Number 9042.

ANALYTICAL PROCEDURE

The two crude oil samples were analyzed by gas chromatography for molecular compositions in the light gasoline (C_4-C_7) range. The heavy saturate and aromatic fractions ($C_{15}+$) were analyzed by mass spectrometry for stable carbon isotope (C^{13}/C^{12}) values and by high mass spectrometry for different molecular types. Gross compositions of the heavy fractions were determined by liquid chromatography.

The oil scums floating on the water in the bottles containing the retorted fluid samples were too low in gasoline content to permit a C_4-C_7 gasoline analysis. Their heavy fractions were analyzed by the same techniques that were used for the heavy fractions of the crude oils.

Hydrocarbons in the sandstone cores were extracted with an organic solvent and the heavy fractions were analyzed by the same techniques used for the heavy fractions of the crude oils. Gasolines were not analyzed in these samples because they had been lost in large part due to their volatility.

The gasolines and the heavy fractions were extracted from the shale core in two separate solvent procedures. These extracts were analyzed by essentially the same procedures used on the crude oil fractions.

DISCUSSION OF RESULTS

The analytical results are summarized for the heavy fractions in Table I and for the C_4-C_7 gasoline fractions in Table II. Table III defines

* The Velasquez oil field is discussed in the AAPG symposium "Habitat of Oil," pp. 687-691. The reservoir sands are in alluvial deposits of probable Eocene age.

significant gasoline ratios that have been found useful in crude oil correlations, and which are listed in Table II.

Figure 1 gives the carbon isotope values for the six samples that were analyzed by this technique. One of the six samples was the extract from the shale core. The six pairs of isotope values are essentially the same, as we would expect if the samples were genetically related.

Figure 2 graphically presents results of molecular analyses of the heavy saturate fractions of the samples. The left column shows the distributions of 4-ring naphthenes for different carbon numbers, from C_{20} thru C_{32}. The humps that appear on these curves in the C_{27}-C_{30} range are assumed to be produced by compounds known as steranes. The steranes have been found in some areas to be useful "fingerprint" molecules in crude oil correlation work. In Fig. 2 these sterane patterns are nearly identical for all the samples except the shale extract (Sample No. 54160). Even though the plot for the shale extract is different from the other plots, it still shows some similarities. If the C_{28} value were somewhat reduced the resemblance of the shale extract curve to the other curves would be fairly close.

The right column in Fig. 2 shows graphically the relative amounts of different saturate molecular types. Again, the curve for the shale extract, Sample No. 54160, is slightly different from the other curves, which are all similar to one another. However, the difference is mainly in relative amounts of 3-Ring (3R) naphthenes. Otherwise, the curves are all similar.

Figure 3 graphically presents light gasoline ratios for the two crude oil samples and the shale extract. These ratios are of groups of gasoline compounds that have been previously found to be useful in crude oil correlation studies. Although Figure 3 shows that the gasolines in the three samples have slight differences in composition, these differences are no greater than we have observed in other areas among samples that were believed to be genetically related. The C_1/C_2 values do suggest that the oils may be in separate reservoir zones rather than in continuous phase.

Figure 4 shows the distribution patterns of different types of heavy aromatic compounds. The solid curve is for the shale extract. The two broken line curves are typical of all the other samples, which have very similar plots. There are several points of distinct dissimilarity between the shale extract curve and the oil curves.

The shale core sample No. 54160 was also analyzed by the standard heavy hydrocarbon (C_{15}+) source potential analysis. The results are given below:

Total Organic Matter	1.19%
Asphaltenes	97 ppm
Saturate Hydrocarbons	9.4 ppm
Aromatic Hydrocarbons	27.5 ppm
Eluted NSO's	63 ppm
Total heavy hydrocarbons	37 ppm
Total C_8 - C_{14} hydrocarbons	312 ppm

The heavy hydrocarbon analysis suggests a poor hydrocarbon source potential but the C_8-C_{14} intermediate hydrocarbon analysis suggests a good oil source potential. It is possible but not certain that the C_8-C_{14} value is high because of contamination from diesel oil, which was used in the drilling mud in this well.

Cuttings gas data, transmitted in our letters of August 25 and Oct. 2, 1967, suggest that the shaly interval above the reservoir zone, from approximately 5350 to 5650 ft., has a good oil source potential. This interval might have contributed hydrocarbons to the reservoired oils represented by the samples of this study, but we do not have sufficient rock material from that interval to permit a comparison of the rock extract with the reservoired oils.

INTERPRETATION

The oil samples throughout the sampled section are genetically related and are similar in most respects. The gasoline compositions in the 5758 ft. and 5829 ft. samples are slightly different, suggesting slightly different histories of oil migration and alteration, but with both coming from the same gross source section.

The shale sample appears to be related to the source section of the oils, but is not completely representative of it. It is typical of the oils in isotope values of heavy hydrocarbon fractions, but differs from the oils in the distribution of heavy aromatic compounds. It differs slightly from the oils in the napthene compound distributions. The gasoline pattern of the shale is nearly identical to that of the upper (5758 ft.) oil, but this might be the result of diffusion of the lighter compounds throughout the oil zone section. Thus, it could be that the gasoline-range hydrocarbons in this particular shale sample are not indigenous. In any case, the shale hydrocarbons still appear to be at least related to the suite of strata that sourced the reservoired oil.

The data summarized in this report do not identify the source of the reservoired oils. They primarily provide a basis for future correlation work in the Norway offshore area.

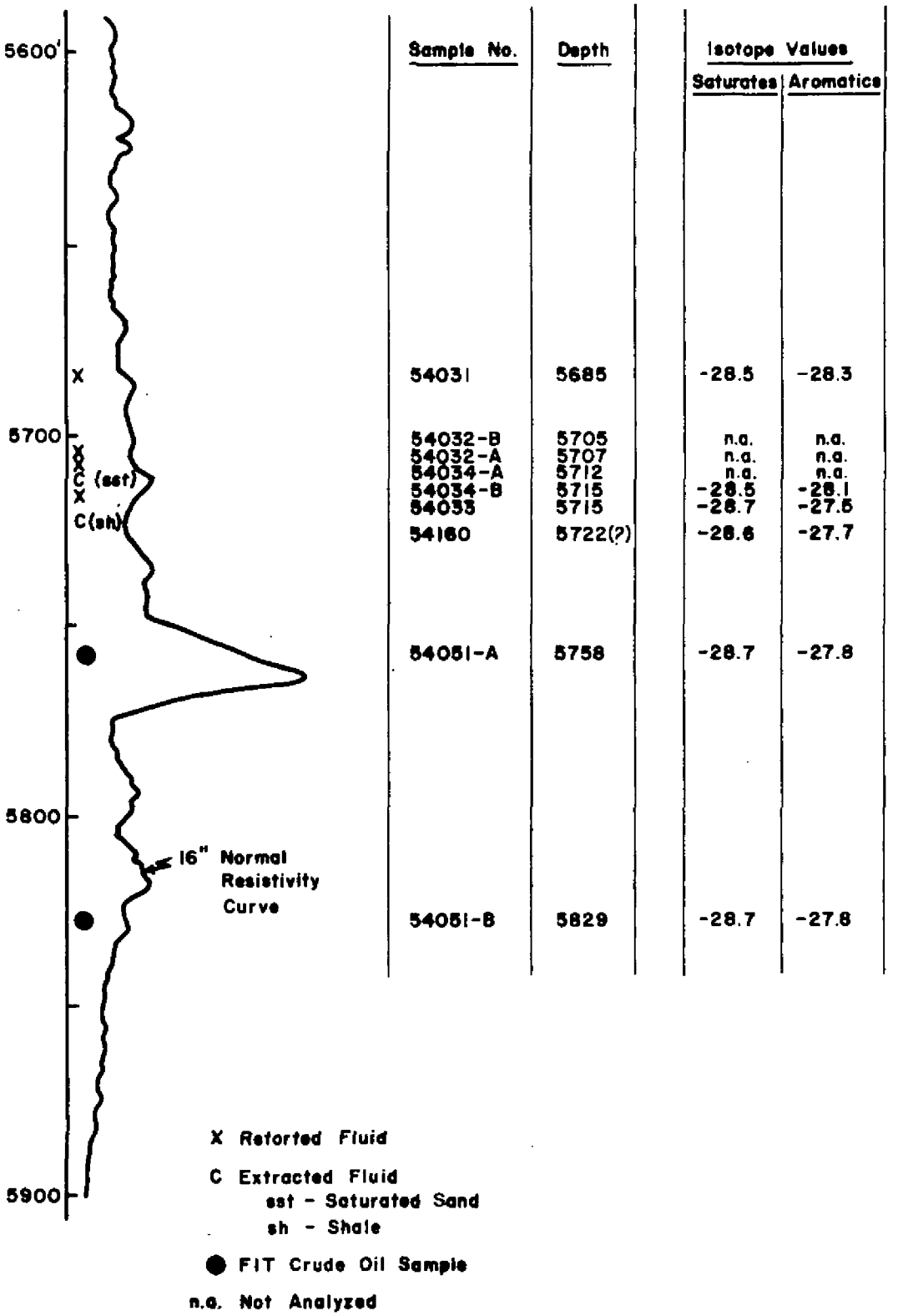

FIG. 1 – SAMPLE LOCATIONS AND CARBON ISOTOPE VALUES.

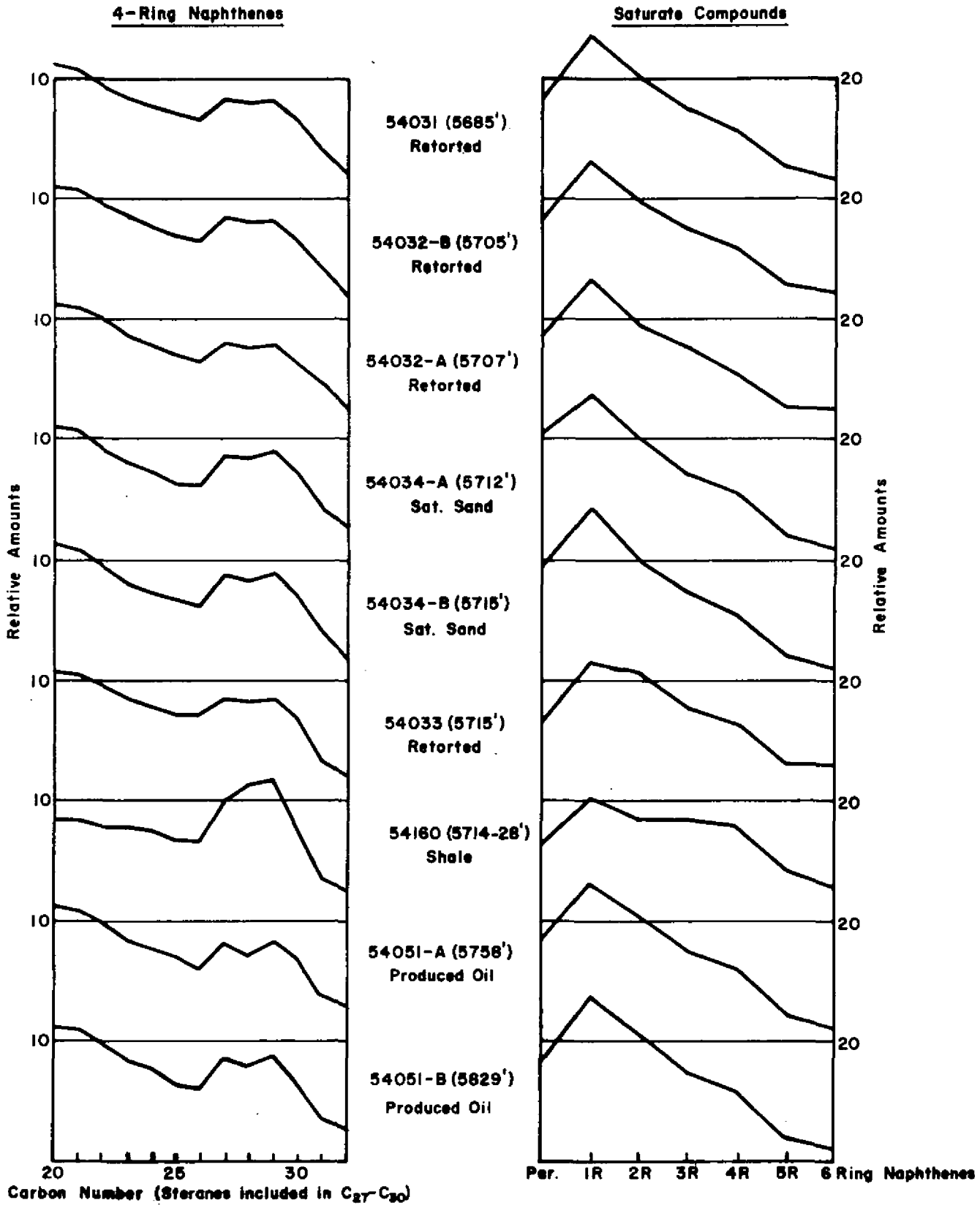

FIG. 2 – RELATIVE AMOUNTS OF C_{15+} SATURATE MOLECULAR TYPES.

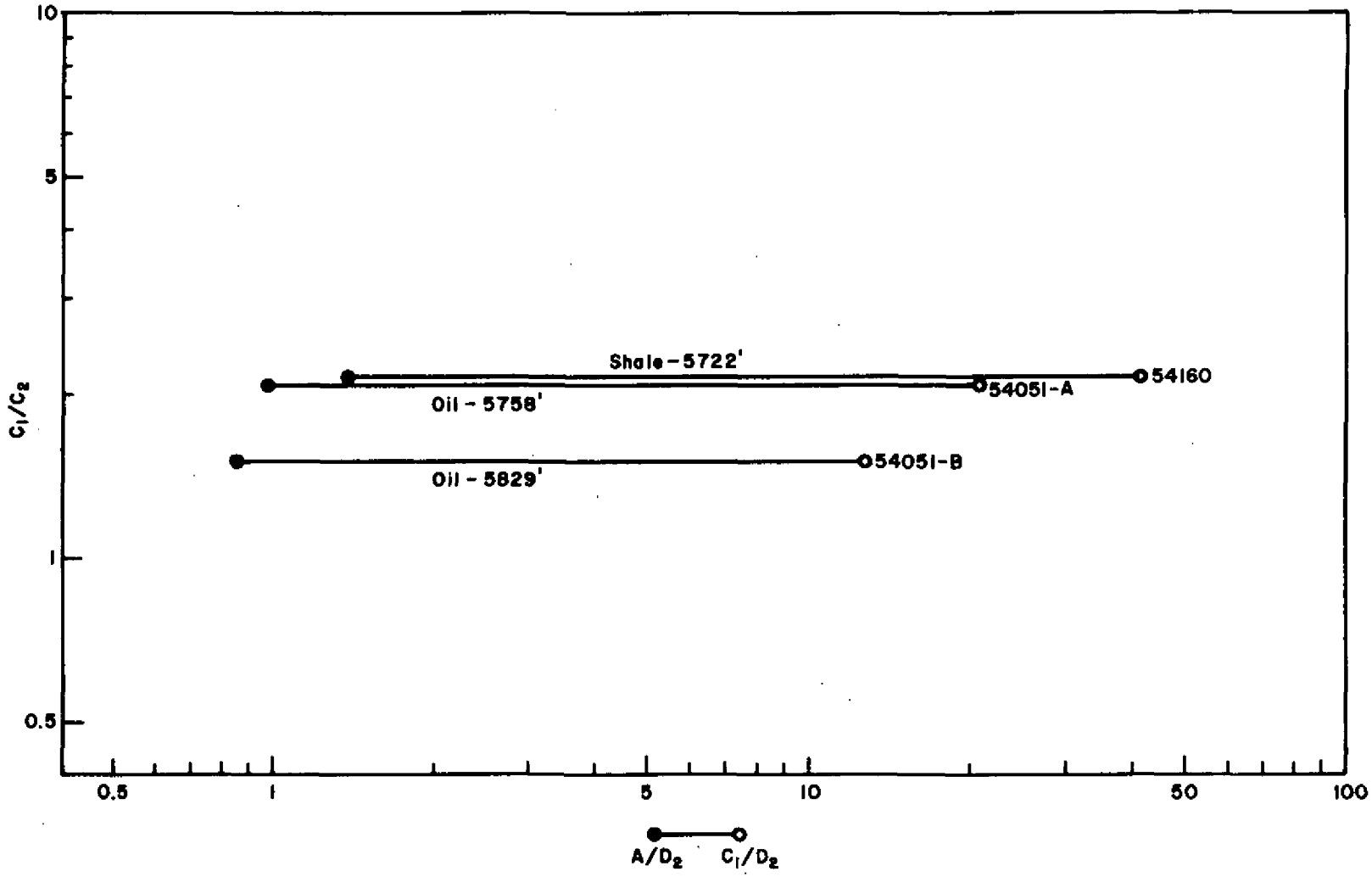

FIG. 3 – SIGNIFICANT GASOLINE RATIOS – CRUDE OILS vs. SHALE EXTRACTS. (See Table III)

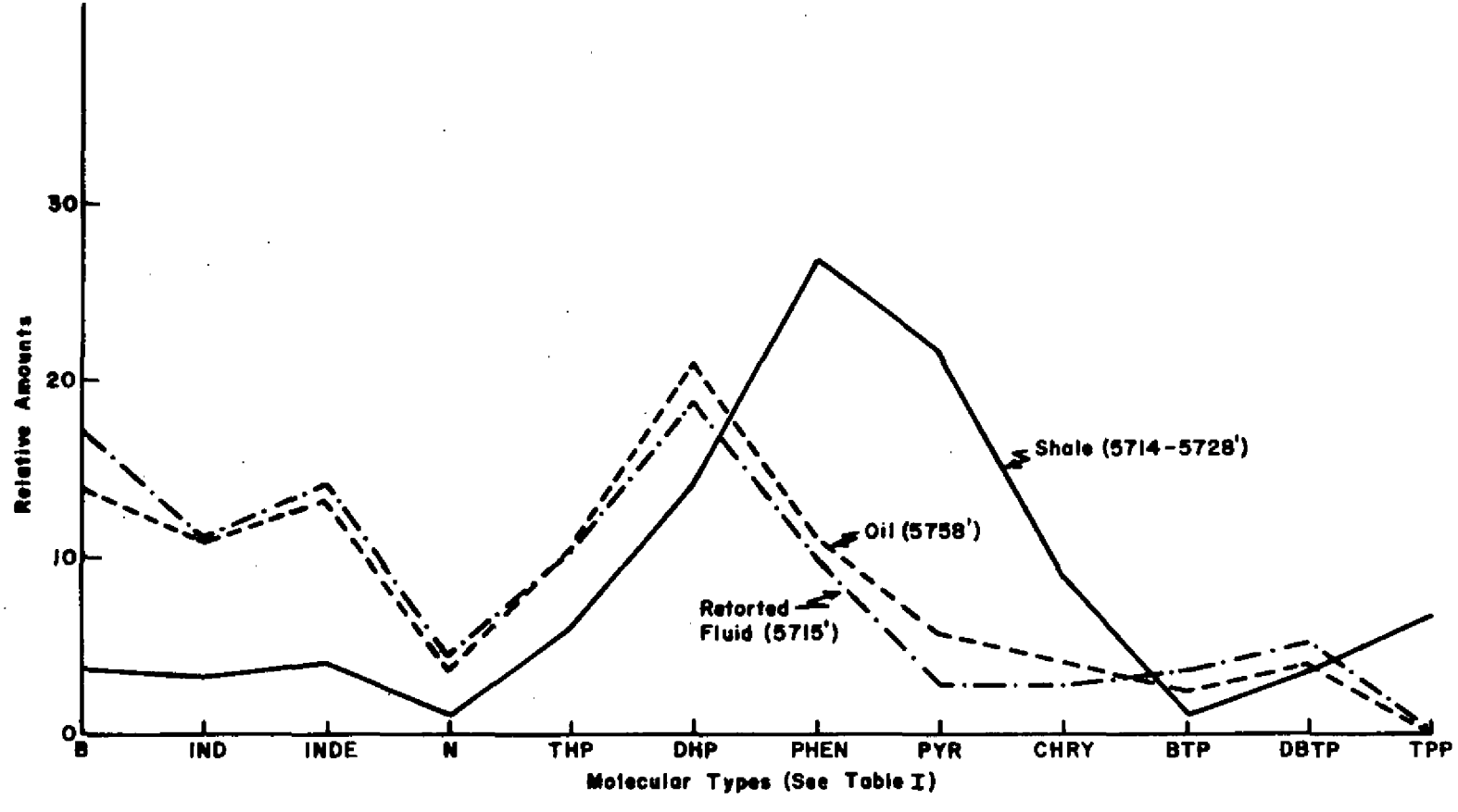

FIG. 4 – RELATIVE AMOUNTS OF C_{15+} AROMATIC TYPES.

TABLE I - Analysis of Heavy Fractions of
Oils, Retort Fluids, and Hydrocarbon
Extracts of Samples from Esso 25/11-1 Well

Sample No.	54031	54032-B	54032-A	54034-A	54031-B	54033	54051-A	54051-B	54160
Depth	5685	5705	5707	5712	5715	5715	5758	5829	5714-28
Type of Sample	Retort	Retort	Retort	Oil Sat.	Oil Sat.	Retort	Crude	Crude	Shale
Gross Composition - %									
Saturates	56.4	55.1	66.4	40.9	36.8	57.2	39.4	39.4	11.7
Aromatics	35.2	33.7	24.7	33.7	32.9	33.0	38.8	39.2	34.4
Eluted NSO's	4.7	7.0	3.2	15.7	23.6	6.2	12.4	12.3	18.9
Noneluted NSO's	2.2	2.1	4.6	4.9	-	1.5	4.2	1.9	5.9
Asphaltenes	1.4	2.1	1.0	4.7	6.7	2.1	5.2	7.2	29.1
	99.9	100.0	99.9	99.9	100.0	100.0	100.0	100.0	100.0
Hydrocarbon Composition - %									
Paraffins	10.3	10.2	12.1	11.5	10.1	8.5	8.7	8.3	3.3
Naphthenes	51.4	51.8	60.7	43.4	42.8	54.8	41.7	41.9	22.3
Aromatics	38.6	38.0	27.1	45.2	47.1	36.7	49.5	49.6	74.4
	100.3	100.0	99.9	100.1	100.0	100.0	99.9	99.8	100.0
Carbon Isotope Values									
Saturates	-28.5	n.a.	n.a.	n.a.	-28.5	-28.7	-28.7	-28.7	-28.6
Aromatics	-28.3	n.a.	n.a.	n.a.	-28.1	-27.5	-27.8	-27.8	-27.7
Heavy Aromatic Molecular Types - %									
Benzenes (B)	15.8	16.3	22.4	15.5	13.8	17.3	13.9	13.7	3.6
Indanes (IND)	10.0	10.0	12.2	11.2	10.6	10.9	10.7	10.3	3.2
Indenes (INDE)	13.9	10.1	16.6	13.2	13.2	14.2	13.2	12.6	4.0
Naphthalenes (N)	4.3	3.9	5.5	4.4	3.9	4.5	3.5	3.2	1.0
Tetrahydrophenanthrenes (THP)	10.6	10.4	10.1	11.1	10.4	10.3	10.6	10.6	6.0
Dihydrophenanthrenes (DHP)	20.0	20.3	16.7	20.2	21.0	18.7	20.9	19.5	14.1
Phenanthrenes (PHEN)	9.8	11.8	6.1	9.9	10.4	10.0	11.0	12.0	26.7
Pyrenes (PYR)	3.8	4.2	1.4	5.1	5.7	2.9	5.7	6.2	21.4
Chrysenes (CHRY)	3.3	3.6	1.1	3.2	4.2	2.7	4.1	4.5	8.9
Benzothiophenes (BTP)	3.4	3.9	3.4	2.8	2.3	3.5	2.4	2.5	1.1
Dibenzothiophenes (DBTP)	5.1	5.5	4.6	3.4	4.4	5.1	3.9	4.5	3.4
Thiophenophenanthrenes (TPP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	6.6
	100.0	100.0	100.1	100.0	99.9	100.1	99.9	99.9	100.0
Saturates - %									
Paraffins	16.7	16.5	16.6	21.0	19.1	13.4	17.3	16.5	13.0
1-Ring Naphthenes	27.4	26.2	26.8	27.5	28.4	23.3	26.5	27.9	20.5
2-Ring Naphthenes	20.1	19.9	19.2	20.0	19.8	21.5	21.1	21.4	17.5
3-Ring Naphthenes	14.9	15.1	15.4	14.2	14.9	15.9	15.3	15.1	17.6
4-Ring Naphthenes	11.6	12.0	11.0	11.1	11.3	13.1	12.5	12.2	16.3
5-Ring Naphthenes	5.6	5.8	5.6	4.1	4.2	6.5	4.7	4.5	9.0
6-Ring Naphthenes	3.7	4.5	5.3	2.1	2.2	6.2	2.6	2.4	6.1
	100.0	100.0	99.9	100.0	99.9	99.9	100.0	100.0	100.0

TABLE II

Light Gasoline Compositions of Oils from Esso 25/11-1 Oils

	54051 A (Oil)	54051 B (Oil)	54160 (Shale)
Depth	5758'	5829'	5714-28'
Isobutane	4.63	9.29	
n-Butane	3.50	3.71	
Isopentane	4.62	5.28	
n-Pentane	2.49	1.91	
2,2 Dimethylbutane	0.42	0.64	
Cyclopentane	1.27	1.78	
2,3 Dimethylbutane	1.27	1.42	
2 Methylpentane	4.26	4.13	
3 Methylpentane	2.26	2.62	
n-Hexane	1.37	1.12	
Methylcyclopentane	10.63	10.44	
2,2 Dimethylpentane	0.0	0.0	
2,4 Dimethylpentane	1.89	1.70	
2,2,3 Trimethylbutane	0.0	0.0	
(Cyclohexane	17.01	14.22	
(3,3 Dimethylpentane	0.19	0.33	
(1,1 Dimethylcyclopentane	0.0	0.0	
(2 Methylhexane	0.95	1.34	
2,3 Dimethylpentane	3.85	4.35	
3 Methylhexane	1.97	2.46	
1-C-3 Dimethylcyclopentane	2.52	2.78	
1-T-3 Dimethylcyclopentane	2.60	3.04	
(1-T-2 Dimethylcyclopentane	3.05	3.80	
(3 Ethylpentane	0.0	0.0	
2,2,4 Trimethylpentane	0.0	0.0	
n-Heptane	0.54	0.74	
1-C-2 Dimethylcyclopentane	0.88	0.96	
Methylcyclohexane	22.66	15.57	
Ethylcyclopentane	1.14	1.68	
Benzene	0.59	0.82	
Toluene	3.44	3.89	
% Light Gasoline in Total Oil	2.95	3.08	
Significant Ratios*			
C_1/C_2	2.07	1.50	2.15
A/D_2	0.97	0.76	1.39
D_1/D_2	2.05	1.91	
C_1/D_2	20.75	12.79	41.84

*See Table III for definitions of ratios

TABLE III

Definition of Significant Gasoline Ratios

Light Gasoline Compounds Determined by Gas Chromatography

1. Pentane
2. Hexane
3. Heptane
4. Iso-Pentane
5. 2-Methylpentane
6. 3-Methylpentane
7. 2,3-Dimethylbutane
8. 2,2-Dimethylbutane
9. 3-Methylhexane
10. 2-Methylhexane + 1,1-Dimethylcyclopentane
11. 2,3-Dimethylpentane
12. 2,4-Dimethylpentane
13. 2,2-Dimethylpentane
14. 2,2,3-Trimethylbutane
15. 2,2,4-Trimethylpentane
16. Cyclopentane
17. Methylcyclopentane
18. 1-c-3-Dimethylcyclopentane
19. 1-t-3-Dimethylcyclopentane
20. 1-c-2-Dimethylcyclopentane
21. 1-t-2-Dimethylcyclopentane _ 3-Ethylpentane*
22. Cyclohexane + 3,3-Dimethylpentane*
23. Methylcyclohexane
24. Benzene
25. Toluene

Significant Groupings of Molecular Data

A. Hexane + Heptane

B. Pentane + iso-Pentane + 2-Methylpentane + 3-Methylpentane

C. Naphthenes

C_1 2-Methylhexane + 1, 1-Dimethylcyclopentane* + Cyclohexane + 3,3-Dimethylpentane* + Methylcyclohexane

C_2 Methylcyclopentane + 1-c-3-Dimethylcyclopentane + 1-t-3-Dimethylcyclopentane + 1-c-2-Dimethylcyclopentane + (1-t-2-Dimethylcyclopentane + 3-Ethylpentane)*

D. Aromatics Plus 3-Methylhexane

D_1 Benzene + Toluene

D_2 3-Methylhexane

* Analyzed together by gas chromatography.

144-0034E

HUMBLE OIL & REFINING COMPANY
MANUFACTURING DIVISION REFINERY LABORATORY BAYTOWN, TEXAS INTERMEDIATE ASSAY

FIELD: ESSO PRODUCTION RESEARCH -- SAMPLE: 54051-A	REPORT DATE: 8-11-67
COUNTY:	DATE DISTILLED:
REPRESENTATIVE OF: One liter sample submitted by	DATE SAMPLED:
P. H. Monaghan, Esso Production Research	ASSAY NO.:
	FILE NO.:
	CARDS:
	COST CENTER: 2501-205 PK 3998
	REPORT BY: J. M. Ellis J. F. HICKERSON

DATA ON CHARGE		VAPOR TEMP., °F	DATA ON PRODUCTS NAPHTHAS			
			C5-175	C5-250	C5-300	C5-375
GRAVITY °API	22.5	RANGE OF CUT, LV%		0.0-2.9	0.0-4.9	0.0-8.7
SULFUR, %, DIETERT	0.71	YIELD, LV%		2.9	4.9	8.7
FLASH, °F, P.M.		GRAVITY, °API				
S.U. VISCOSITY AT 100°F		RESEARCH OCTANE NO.				
80°F		+1.5 CC TEL				
60°F		+3.0 CC TEL				
40°F		MOTOR OCTANE NO.				
B.S. & W., %		+1.5 CC TEL				
WATER BY DISTILLATION, %		+3.0 CC TEL				
REID VAPOR PRESSURE, LB.		REID VAPOR PRESSURE, LB.				
POUR POINT, °F	10	SULFUR, %, LAMP				
SALT AS NACL, PTB		MERCAPTAN NO., MG/100 CC.		—	—	
NEUTRALIZATION VALUE, D664		% AT 158°F. + LOSS				
HYDROCARBON ANAL., LV%:	—	212°				
C2 & LIGHTER		257°				
C3		284°				
iC4		302°				
NC4		F.B.P., °F				
iC5		LOSS, %				
NC5						
MERCAPTAN NO., MG/100 CC.						
COLOR, SAYBOLT						
COLOR, ROBINSON						

VAPOR TEMPERATURE, °F	HEAVY NAPHTHAS			KEROSENE & TURBO FUELS		
	250-375	175-300	350-375	375-530	300-500	375-480
RANGE OF CUT, LV%	2.9-8.7	0.0-4.9	7.4-8.7	8.7-23.7	4.9-18.5	8.7-15.7
YIELD, LV%	5.8	4.9	1.3	15.0	13.6	8.0
MIDPOINT OF CUT, °F			—	—	—	—
GRAVITY, °API				33.6	36.7	
RESEARCH OCTANE NO., CALC.			—	—	—	—
SULFUR, %, LAMP			—	0.089	0.055	—
ANILINE POINT, °F						
MERCAPTAN NO., MG/100 CC.	—	—	—			—
VISCOSITY, SAY. THERMO	—	—				
VISCOSITY, KINEMATIC, @-40°F., CS	—	—	—			—
FREEZING POINT, °F	—	—		-60	-90	
RING NUMBER	—	—				
I.P.T. SMOKE POINT, MM.						
COLOR, SAYBOLT	—	—	—			—
AROMATICS, LV%, M.S.	17.3	4.7	—	—	—	—
NAPHTHENES, LV%, M.S.	64.3	75.4	—	—	—	—
PARAFFINS, LV%, M.S.	18.4	19.9	—	—	—	—
AROMATICS, LV%, F.I.A.	—	—	—	23.5	22.5	—
LUMINOMETER NO.	—	—	—		—	—
REFRACTIVE INDEX, NO 20°C			—	—	—	—
VISCOSITY, KINEMATIC @ 100°F., CS.	—	—	—			—

:mk

544-0035B

FIELD: ESSO PRODUCTION RESEARCH -- SAMPLE: 54051-A

ASSAY NO.: FILE NO.: INTERMEDIATE ASSAY, PAGE 2

VAPOR TEMPERATURE, °F	MIDDLE DISTILLATES			GAS OILS		
		430-530	530-650	650-850	850-990	1050-
RANGE OF CUT, LV%		11.6-23.7	23.7-38.7	38.7-56.1	56.1-72.3	
YIELD, LV%		12.1	15.0	17.4	16.2	
GRAVITY, °API		32.6	28.1	21.4	18.5	
REFRACTIVE INDEX, NO67°C.						
SULFUR, %, DIETERT						
ANILINE POINT, °F						
DIESEL INDEX						
POUR POINT, °F						
CONRADSON CARBON, %		—				
NITROGEN, WT. %		—				
AROMATIC RINGS, CALC.						
NAPHTHENE RINGS, CALC.						
WET ASH, PPM Ni	—	—	—	—		—
V	—	—	—	—		—
Fe	—	—	—	—		—
S.U. VISCOSITY AT 100°F.	—	—	—			—
130°	—	—	—			
150°	—	—	—			
175°	—	—	—			
210°	—	—	—			
NEUTRALIZATION VALUE D974		—				

VAPOR TEMPERATURE, °F	WAXY LUBE OIL	DEWAXED LUBE	BOTTOMS		CORRELATED DATA
	790-990		BEYOND 1050	BEYOND 990+	PHENOL TREATING CHARACTERISTICS ON NARROW LUBE CUT DEWAXED
RANGE OF CUT, LV%	51.3-72.3			72.3-100.0	
YIELD, LV%	21.0	—		27.7	
GRAVITY, ° API	19.5	17.8		8.1	
SULFUR, %, DIETERT	1.0	—		1.59	
ANILINE POINT, °F		170	—	—	% TREAT V.I.
DIESEL INDEX			—	—	0
S.U. VISCOSITY AT 100°F	—	1508	—	—	100
130°F	388	—	—	—	200
150°F		—	—	—	300
175°F		—	—	—	V.G.C.
210°	71.9	78.2			
S.F. VISCOSITY AT 122°F	—	—			
210°	—	—		1254	
275°	—	—			
300°	—	—			
FLASH, °F, C.O.C.					
POUR POINT, °F		5	—	—	
VISCOSITY INDEX	27.8	4.5	—	—	
NEUTRALIZATION VALUE D664	0.67*	—			*D974
WAX, S.B.A., %		—	—	—	
CONRADSON CARBON, %	—	—			
MOD. INSOL. IN 86° NAPH.	—	—		6.5; 6.8	
CLAY GEL:	—	—			
Saturates	—	—		19.4	
Aromatics	—	—		33.9	
Polars	—	—		42.4	
Asphaltenes	—	—		4.3	
SOFTENING POINT, °F	—	—			
PENETRATION AT 77°F	—	—			
PENETRATION AT 39.2 °F	—	—			
DUCTILITY AT 77°F	—	—			
SOLUBLE IN CCl4	—	—			

644-4018A

HUMBLE OIL & REFINING COMPANY REFINERY LABORATORY BAYTOWN, TEXAS

INTERMEDIATE ASSAY BOILING POINT CHART 1

TEMP.	DATE	ASSAY NO.	FIELD	FILE NO.:
	8-11-67		ESSO PRODUCTION RESEARCH - SAMPLE: 54051-A	

TEMP.	MID LV %, VS GRAVITY °API	MID LV %, VS THERMO VIS	MID LV %, VS SMOKE POINT	FREEZING POINT, °F	SULFUR, %
1300					
1200	90				
1100	80	600			
1000	70	500			
900	60	400			
800	50	300			
700	40	200			
600	30				
500	20				
400	10				
300	0				
200					
100					

0 10 20 30 40 50 60 70 80 90 100

LV % DISTILLED OR MID LV %

544-00341

HUMBLE OIL & REFINING COMPANY
MANUFACTURING DIVISION REFINERY LABORATORY BAYTOWN, TEXAS INTERMEDIATE ASSAY

FIELD: ESSO PRODUCTION RESEARCH - SAMPLE: 54051-B	REPORT DATE: 8-11-67
COUNTY:	DATE DISTILLED:
REPRESENTATIVE OF: One liter sample submitted by	DATE SAMPLED:
P. H. Monaghan, Esso Production Research	ASSAY NO.:
	FILE NO.:
	CARDS:
	COST CENTER: 2501-205
	REPORT BY: J. M. Erickson J. F. HICKERSON

DATA ON CHARGE		VAPOR TEMP., °F	DATA ON PRODUCTS NAPHTHAS			
			C5-175	C5-250	C5-300	C5-375
GRAVITY °API	22.2					
SULFUR, %, DIETERT	0.79					
FLASH, °F, P.M.		RANGE OF CUT, LV%	1.7-2.0	1.7-5.2	1.7-7.8	1.7-11.8
S.U. VISCOSITY AT 100°F		YIELD, LV%	2.0	5.2	7.8	11.8
80°F		GRAVITY, °API				
60°F		RESEARCH OCTANE NO.				
40°F		+1.5 CC TEL				
B.S. & W., %		+3.0 CC TEL				
WATER BY DISTILLATION, %		MOTOR OCTANE NO.				
REID VAPOR PRESSURE, LB.		+1.5 CC TEL				
POUR POINT, °F	10	+3.0 CC TEL				
SALT AS NACL, PTB		REID VAPOR PRESSURE, LB.				
NEUTRALIZATION VALUE, D664		SULFUR, %, LAMP				
HYDROCARBON ANAL., LV%:	—	MERCAPTAN NO., MG/100 CC.		—	—	
C2 & LIGHTER		% AT 158°F. + LOSS				
C3		212°				
iC4		257°				
NC4		284°				
iC5		302°				
NC5		F.B.P., °F				
MERCAPTAN NO., MG/100 CC.		LOSS, %				
COLOR, SAYBOLT						
COLOR, ROBINSON						

VAPOR TEMPERATURE, °F	HEAVY NAPHTHAS			KEROSENE & TURBO FUELS		
	250-375	175-300	350-375	375-530	300-500	375-480
RANGE OF CUT, LV%	5.2-11.8	2.0-7.8		11.8-26.7	7.8-22.7	
YIELD, LV%	6.6	5.8		14.9	14.9	
MIDPOINT OF CUT, °F			—	—	—	—
GRAVITY, °API				33.2	36.2	
RESEARCH OCTANE NO., CALC.			—	—	—	—
SULFUR, %, LAMP			—	0.087	0.058	—
ANILINE POINT, °F						
MERCAPTAN NO., MG/100 CC.	—	—	—			—
VISCOSITY, SAY. THERMO	—	—				
VISCOSITY, KINEMATIC, @ 40°F., CS	—	—	—			—
FREEZING POINT, °F	—	—		-56	-79	
RING NUMBER	—	—				
U.P.T., SMOKE POINT, MM.						
COLOR, SAYBOLT	—	—	—			—
AROMATICS, LV%, M.S.	31.4	6.6	—	—	—	—
NAPHTHENES, LV%, M.S.	50.5	74.3	—	—	—	—
PARAFFINS, LV%, M.S.	18.1	19.1	—	—	—	—
AROMATICS, LV%, F.I.A.	—	—	—	25.5	22.5	—
LUMINOMETER NO.	—	—	—		—	—
REFRACTIVE INDEX, ND 20°C			—	—	—	—
VISCOSITY, KINEMATIC @ 100°F., CS.	—	—	—			—

:mk

544-00358

FIELD: ESSO PRODUCTION RES. CO. - SAMPLE: 54051-B

ASSAY NO.: FILE NO.:

VAPOR TEMPERATURE, °F	MIDDLE DISTILLATES			GAS OILS		
		430-530	530-650	650-850	850-1000	1050-
RANGE OF CUT, LV%		15.5-26.7	26.7-38.7	38.7-53.7	53.7-70.5	
YIELD, LV%		11.2	12.0	15.0	16.8	
GRAVITY, °API		32.2	27.9	21.6	19.1	
REFRACTIVE INDEX, ND67°C.						
SULFUR, %, DIETERT						
ANILINE POINT, °F						
DIESEL INDEX						
POUR POINT, °F						
CONRADSON CARBON, %		—				
NITROGEN, WT. %		—				
AROMATIC RINGS, CALC.						
NAPHTHENE RINGS, CALC.						
WET ASH, PPM Ni	—	—	—	—		—
V	—	—	—	—		—
Fe	—	—	—	—		—
S.U. VISCOSITY AT 100°F.	—	—	—			—
130°	—	—	—			
150°	—	—	—			
175°	—	—	—			
210°	—	—	—			
NEUTRALIZATION VALUE D974		—				

VAPOR TEMPERATURE, °F	WAXY LUBE OIL	DEWAXED LUBE	BOTTOMS		CORRELATED DATA
	790-1000		BEYOND 1050	BEYOND 1000	PHENOL TREATING CHARACTERISTICS ON NARROW LUBE CUT DEWAXED
RANGE OF CUT, LV%	49.6-70.5			70.5-100.0	
YIELD, LV%	20.9	—		29.5	
GRAVITY, ° API	20.2	19.0		9.4	
SULFUR, %, DIETERT	0.76	—		1.39	
ANILINE POINT, °F		168	—	—	% TREAT V.I.
DIESEL INDEX			—	—	0
S.U. VISCOSITY AT 100°F	720	899	—	—	100
130°F		—	—	—	200
150°F		—	—	—	300
175°F		—	—	—	V.G.C.
210°	61.1	64.5			
S.F. VISCOSITY AT 122°F	—	—			
210°	—	—		650	
275°	—	—			
300°	—	—			
FLASH, °F, C.O.C.					
POUR POINT, °F		0	—	—	
VISCOSITY INDEX	27.2	12.6	—	—	
NEUTRALIZATION VALUE D664		—			*D974
WAX, S.B.A., %		—	—	—	
CONRADSON CARBON, %	—	—			
MOL. INSOL. IN 86° NAPH.	—	—		5.4; 5.2	
CLAY GEL:	—	—			
Saturates	—	—		25.0	
Aromatics	—	—		43.1	
Polars	—	—		28.6	
Asphaltenes	—	—		3.3	
SOFTENING POINT, °F	—	—			
PENETRATION AT 77°F	—	—			
PENETRATION AT 39.2 °F	—	—			
DUCTILITY AT 77°F	—	—			
SOLUBLE IN CCl_4	—	—			

844-4018A

HUMBLE OIL & REFINING COMPANY REFINERY LABORATORY BAYTOWN, TEXAS

INTERMEDIATE ASSAY BOILING POINT CHART 1

TEMP.	DATE	ASSAY NO.	FIELD	FILE NO.:
	8-11-67		ESSO PRODUCTION RESEARCH - SAMPLE: 54051-B	

TEMP.	MID LV % VS GRAVITY °API	MID LV % VS THERMO VIS	MID LV % VS SMOKE POINT	FREEZING POINT, °F	SULFUR, %
1300					
1200	90				
1100	80	600			
1000	70	500			
900	60	400			
800	50	300			
700	40	200			
600	30				
500	20				
400	10				
300	0				
200					
100					

0 10 20 30 40 50 60 70 80 90 100

LV % DISTILLED OR MID LV %