

TJ E 178

Insolubles from Shale Derived Diesel Fuel Marine With Antioxidant¹
And Added 2,5-Dimethylpyrrole²

N added (ppm - w/v)	mg/100 ml					Std. Dev.
	Filtered Sediment	Adherent	Duplicates	Mean	Total Insolubles	
0	0.0 0.0	0.4 ---	0.4 ---	---	---	---
45	19.7 19.4	2.2 2.3	21.9 21.7	21.8	± 0.1	
45 ³	18.1 17.3	2.2 1.8	20.3 19.1	19.7	± 0.8	
135	63.9 62.6	3.7 3.2	67.6 65.8	66.7	± 1.3	
270	137.3 130.2	5.1 6.4	142.4 136.6	139.5	± 4.1	
450	205.5 194.9	6.3 9.1	211.8 204.0	207.9	± 5.5	
450 ³	196.1 176.7	7.3 6.7	203.4 183.4	193.4	± 14.1	

¹ 24 mg/l of 2, 4-dimethyl-6-t-butylphenol

² Aged at 80 °C for 21 days

³ Flasks vented

Taken from Reference No. 47

TABLE 179

Insolubles from Shale Derived Diesel Fuel Marine with Antioxidant¹ and Added 2,5-Dimethylpyrrole²

N added (ppm-w/v)	mg / 100 ml				Std. Dev.
	Total Insolubles				
	Filtered Sediment	Adherent Gum	Duplicates	Mean	
0	0.2 1.2	-0.2 0.5	0.0 1.7	0.9	± 1.2
45	23.7 23.3	2.3 2.4	26.0 25.7	25.9	± 0.2
45 ³	22.8 23.2	2.5 2.3	25.3 25.5	25.4	± 0.1
135	73.2 58.3	4.0 4.0	77.2 62.3	69.8	± 10.5
270	146.3 146.5	5.8 6.7	152.1 153.2	152.7	± 0.8
450	102.1 ⁴ 237.4	5.0 8.9	107.1 246.3	176.7	± 98.4
450 ³	231.4 231.7	8.4 7.7	239.8 239.4	239.6	± 0.3

¹ 24 mg/l of 2,4-dimethyl-6-t-butylphenol² Aged at 80° C (176° F) for 28 days³ Flask vented⁴ Anomalous results

Taken from Reference No. 47

TABLE 180
Insolubles from Shale-Derived Diesel Fuel Marine Blanks¹

mg/100 ml					
Length of Stress (Days)	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
21	0.2	2			
	3.6	6.2	9.8		
	5.3	2.3	7.6	8.7	± 1.5
28	13.5	11.3	24.8		
	1.0	0.2	1.2		
	0.4	0.7	1.1	9.0	± 13.7

¹Fuel only, no nitrogen compound added. Stressed at 80 °C.

²Flask broken.

Taken from Reference No. 47

TABLE 181
Insolubles from Shale-Derived Diesel Fuel Marine With Added 2,5-Dimethylpyrrole¹

mg/100 ml					
N Added (ppm w/v)	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
0	0.1	0.2	0.3		
	0.1	0.0	0.1	0.2	± 0.1
45	6.1	0.9	7.0		
	4.9	0.6	5.5	6.3	± 1.1
45 ²	4.4	0.5	4.9		
	5.0	0.9	5.9	5.4	± 0.7
135	17.7	1.5	19.2		
	21.8	1.9	23.7	21.5	± 3.2
270	41.3	2.2	43.5		
	38.3	1.8	40.1	41.8	± 2.4
450	49.5	2.6	52.1		
	110.7	4.7	115.4	83.8	± 44.8
450 ²	53.9	2.2	56.1		
	55.2	2.8	58.0	57.1	± 1.3

¹aged at 65 °C for 11 days
flasks vented

Taken from Reference No. 47

TABLE 182
Insolubles from Shale-Derived Diesel Fuel Marine
With Added 2,5-Dimethylpyrrole¹

N Added (ppm w/v)	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
0	- 0.1	0.0	- 0.1	- 0.1	± 0.1
	0.0	-0.2	- 0.2		
45	9.0	0.8	9.8	9.9	± 0.1
	9.2	0.8	10.0		
45 ²	9.0	0.7	9.7	9.5	± 0.4
	8.6	0.6	9.2		
135	30.1	2.2	32.3	31.5	± 1.1
	28.9	1.8	30.7		
270	45.2	2.2	47.4	60.3	± 32.4
	69.3	3.9	73.2		
450	68.5	3.2	71.7	78.6	± 9.7
	80.7	4.7	85.4		
450 ²	125.2	4.9	130.1	135.1	± 7.1
	134.7	5.4	140.1		

¹ Aged at 65 °C for 20 days

² Flasks vented

Taken from Reference No. 47

TABLE 183
Insolubles from Shale-Derived Diesel Fuel Marine
With Added 2,5-Dimethylpyrrole¹

N Added (ppm-w/v)	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
0	0.1	-0.3	-0.2		
	0.1	-0.4	-0.3	-0.2	± 0.1
45	15.3	1.5	16.8		
	18.8	1.9	20.7	18.8	± 2.8
45 ²	14.2	1.3	15.5		
	16.0	1.2	17.2	16.4	± 1.2
135	49.8	3.6	53.4		
	55.2	3.4	58.6	56.0	± 3.7
270	94.8	5.4	100.2		
	102.2	5.1	107.3	103.8	± 5.0
450	167.5	7.6	175.1		
	219.1	8.4	227.5	201.3	±37.3
450 ²	185.6	7.2	192.8		
	165.9	7.5	173.4	183.1	±13.7

¹ Aged at 65 °C for 32 days

² Flasks vented

Taken from Reference No. 47

TABLE 184
Insolubles from Shale-Derived Diesel Fuel Marine
With Added 2,5-Dimethylpyrrole¹
Run 1

N Added (ppm-w/v)	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
0	0.1	0.5	0.6		
	0.0	0.2	0.2	0.4	± 0.3
45	21.5	2.0	23.5		
	21.3	1.9	23.2	23.4	± 0.2
45 ²	18.6	1.6	20.2		
	20.9	1.9	22.8	21.5	± 1.8
135	69.9	3.6	73.5		
	67.9	4.8	72.7	73.1	± 0.6
270	61.7	3.7	65.4		
	126.4	6.0	132.4	98.9	±47.4
450	67.6	4.2	71.8		
	69.9	3.7	73.6	72.7	± 1.3
450 ²	220.1	7.4	227.5		
	240.0	7.5	247.5	237.5	±14.1

¹ Aged at 65 °C for 50 days

²Flasks vented

Taken from Reference No. 47

TABLE 185
Insolubles from Shale-Derived Diesel Fuel Marine
With Added 2,5-Dimethylpyrrole¹
Second Run

N Added (ppm-w/v)	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
0	3 0.1	-0.2	-0.1	-0.1	-
45	20.9 18.3	2.8 2.2	23.7 20.5	22.1	± 2.3
45 ²	18.5 19.0	2.6 2.4	21.1 21.4	21.3	± 0.2
135	63.6 97.8	4.0 4.8	67.6 102.6	85.1	±24.7
270	133.3 124.0	7.5 5.9	140.8 129.9	135.4	± 7.7
450	248.8 247.3	11.6 11.7	260.4 259.0	259.7	± 1.0
450 ²	217.4 222.0	9.3 9.7	226.7 231.7	229.2	± 3.5

¹ Aged at 65 °C for 50 days

² Flasks vented

³ Flask broken

Taken from Reference No. 47

TABLE 186
Insolubles from Shale-Derived Diesel Fuel Marine
With Added Nitrogen Compounds¹

mg/100 ml					
N Compound Added ²	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
2-Methylindole	0.6	0.0	0.6	0.5	± 0.2
	0.6	-0.3	0.3		
3-Methylindole	60.4	11.0	71.4	80.0	±12.2
	74.2	14.4	88.6		
2-Methylpyridine	0.1	0.2	0.3	0.5	± 0.3
	0.2	0.5	0.7		
2,6-Dimethyl- pyridine	0.5	18.3	18.8	12.5	± 8.9
	0.6	5.6	6.2		
3,5-Dimethyl- pyridine	0.2	2.5	2.7	2.9	± 0.3
	0.3	2.8	3.1		
5-Ethyl-2-methyl- pyridine	0.2	0.5	0.7	0.7	± 0.0
	0.2	0.5	0.7		
2-Benzylpyridine	0.0	1.8	1.8	3.7	± 2.6
	0.4	5.1	5.5		
4-t-Butylpyridine	0.6	9.2	9.8	7.4	± 3.4
	0.2	4.8	5.0		
2-Methylquinoline	0.3	2.1	2.4	2.0	± 0.6
	0.2	1.3	1.5		
4-Methylquinoline	0.3	3.0	3.3	2.5	± 1.2
	0.2	1.4	1.6		
2,6-Dimethyl- quinoline	0.2	0.3	0.5	4.0	± 4.9
	1.6	5.9	7.5		
4-iso-Butyl- quinoline	0.6	3.0	3.6	3.7	± 0.1
	0.4	3.4	3.8		
1,2,3,4-Tetra- hydroquinoline	0.3	0.1	0.4	0.3	± 0.1
	0.2	0.0	0.2		
5,6,7,8-Tetra- hydroquinoline	0.5	0.0	0.5	0.8	± 0.4
	0.6	0.4	1.0		

¹ Aged at 80 °C for 14 days

² Added at 450 ppm N level

Taken from Reference No. 47

TABLE 187
Insolubles from Shale-Derived Diesel Fuel Marine
Containing Antioxidant With Added Nitrogen Compounds¹

N Compound Added ²	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
2-Methylindole	0.3	0.1	0.4		
	0.2	0.2	0.4	0.4	±0.0
3-Methylindole	0.8	0.0	0.8		
	0.8	0.1	0.9	0.9	±0.1
2-Methyl- pyridine	0.0	0.1	0.1		
	0.1	-0.1	0.0	0.1	±0.1
2,6-Dimethyl- pyridine	0.3	0.0	0.3		
	0.3	0.3	0.6	0.5	±0.2
3,5-Dimethyl- pyridine	0.4	0.6	1.0		
	0.4	0.7	1.1	1.1	±0.1
5-Ethyl-2-methyl- pyridine	0.0	-0.3	-0.3		
	0.0	-0.2	-0.2	-0.2	±0.1
2-Benzylpyridine	0.3	0.0	0.3		
	1.9	0.3	2.2	1.3	±1.3
4-t-Butylpyridine	0.3	0.3	0.6		
	0.3	0.7	1.0	0.8	±0.3
2-Methylquinoline	0.0	0.0	0.0		
	0.1	0.1	0.2	0.1	±0.1
4-Methylquinoline	0.4	0.6	1.0		
	0.5	1.3	1.8	1.4	±0.6
2,6-Dimethyl- quinoline	0.4	0.3	0.7		
	0.4	0.6	1.0	0.9	±0.2
4-iso-Butyl- quinoline	0.3	0.1	0.4		
	0.3	0.1	0.4	0.4	±0.0
1,2,3,4-Tetra- hydroquinoline	0.1	0.4	0.5		
	0.1	0.3	0.4	0.5	±0.1
5,6,7,8-Tetra- hydroquinoline	0.4	0.0	0.4		
	0.4	0.1	0.5	0.5	±0.1

¹ Aged at 80 °C for 14 days

² Added at 450 ppm N level

TABLE 188
Insolubles from Shale-Derived Diesel Fuel Marine
With Added Nitrogen Compounds¹

N Compound Added ²	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
2-Methylpyrrole	8.3	1.4	9.7		
	7.9	1.5	9.4	9.6	±0.2
2,4-Dimethyl- pyrrole	39.4	190.8	230.2		
	36.2	195.2	231.4	230.8	± 0.8
1,2,5-Trimethyl- pyrrole	76.3	5.4	81.7		
	214.3	7.9	222.2	152.0	±99.3
Pentamethyl- pyrrole	43.4	6.6	50.0		
	39.5	5.8	45.3	47.7	± 3.3
2-Acetyl-1- methylpyrrole	0.5	2.4	2.9		
	0.4	2.6	3.0	3.0	± 0.1
Pyrrolidine	0.2	2.9	3.1		
	0.2	3.0	3.2	3.2	± 0.1
1-Methyl- pyrrolidine	0.4	4.9	5.3		
	0.3	3.6	3.9	4.6	± 1.0
3,5-Dimethyl- pyrazole	1.1	1.3	2.4		
	1.7	1.3	3.0	2.7	± 0.4
2,3-Dimethyl- indoline	12.0	2.6	14.6		
	15.3	3.2	18.5	16.6	± 2.8
2-Methyl- piperidine	1.2	1.9	3.1		
	1.3	2.1	3.4	3.3	± 0.2
2-Methyl- pyrazine	0.6	0.8	1.4		
	-0.1	0.9	0.8	1.1	± 0.4
2,5-Dimethyl- pyrazine	0.3	0.8	1.1		
	0.2	0.7	0.9	1.0	± 0.1
3-Methyl- isoquinoline	1.5	3.5	5.0		
	1.6	4.7	6.3	5.7	± 0.9

¹ Aged at 80 °C for 14 days

² Added at 450 ppm N level.

TABLE 189
Insolubles from Shale-Derived Diesel Fuel Marine
With Added Nitrogen Compounds¹

N Compound Added ²	mg/100 ml				
	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
2,6-Dimethyl- quinoline	0.3	-0.2	0.1		
	0.5	0.0	0.5	0.3	± 0.3
1,2,3,4-Tetra- hydroquinoline	0.1	-0.5	-0.4		
	0.2	0.0	0.2	-0.1	± 0.4
4-Methyl- quinoline	0.1	-0.4	-0.3		
	0.2	-0.2	0.0	-0.1	± 0.2
2-Methyl- quinoline	0.1	-0.8	-0.5		
	0.1	-0.1	0.0	-0.2	± 0.4
3,5-Dimethyl- pyridine	0.1	-0.4	-0.3		
	0.1	-0.1	0.0	-0.1	± 0.2
2-Methyl- pyridine	0.1	-0.4	-0.3		
	0.1	-0.2	-0.1	-0.2	± 0.1
2-Methylindole	0.3	-0.3	0.0		
	.3	-0.3	0.0	0.0	± 0.0

¹ Aged at 43 °C for 80 days

² Added at 450 ppm N level.

Taken from Reference No. 47

TABLE 190
Insolubles from Shale-Derived Diesel Fuel Marine
With Added Nitrogen Compounds¹

N Compound Added ²	mg/100 ml			
	Filtered Sediment	Adherent Gum	Total Insolubles	
			Duplicates	Mean Std. Dev.
2-Methyl- pyridine	165.9	5.1	171.0	170.7 ± 0.4
	167.0	3.4	170.4	
3,5-Dimethyl- pyridine	170.1	4.0	174.1	176.1 ± 2.8
	173.5	4.6	178.1	
2-Methyl- quinoline	158.7	3.8	162.5	165.5 ± 4.2
	164.1	4.4	168.5	
4-Methyl- quinoline	168.3	3.9	172.2	174.3 ± 2.9
	171.0	5.3	176.3	
1,2,3,4-Tetra- hydroquinoline	116.6	3.2	119.8	130.3 ± 14.8
	136.1	4.6	140.7	
2-Methylindole	158.2	4.0	162.2	166.4 ± 5.9
	166.3	4.3	170.6	
3-Methylindole	172.5	4.1	176.6	180.7 ± 5.8
	180.4	4.4	184.8	

¹ Aged at 80 °C for 14 days

² Added at 450 ppm N level.

All test blends also contain 450 ppm N as 2, 5-dimethylpyrrole.

Taken from Reference No. 47

TABLE 191
Insolubles from Shale-Derived Diesel Fuel Marine
With Added Nitrogen Compounds¹

N Compound Added ²	mg/100 ml		Total Insolubles		
	Filtered Sediment	Adherent Gum	Duplicates	Mean	Std. Dev.
2,6-Dimethyl- quinoline	187.7 211.9	6.1 6.4	193.8 210.3	206.1	± 17.3
5,6,7,8-Tetra- hydroquinoline	184.1 153.7	4.7 5.1	188.8 158.8	173.8	± 21.2
5-Ethyl-2-methyl- pyridine	125.4 198.4	4.9 5.6	130.3 204.0	167.2	± 52.1
2-Benzyl- pyridine	210.4 205.4	5.3 6.0	215.6 211.4	213.5	± 3.0
4-Isobutyl- quinoline	190.5 182.5	5.0 5.3	195.5 187.8	191.7	± 5.4
4-t-Butyl- pyridine	214.8 158.8	5.4 5.0	220.2 161.8	191.0	± 41.3
2,6-Dimethyl- pyridine	178.1 184.1	5.5 5.5	183.6 189.6	186.6	± 4.2

¹ Aged at 81 °C for 14 days

² Added at 450 ppm N level

All test blends also contain 450 ppm N as 2, 5-dimethylpyrrole

Taken from Reference No. 47

TABLE 192

Insolubles from Exxon Shale Fuels¹

Exxon Sample ²	Total ppm N	mg/100 ml					Result of stress ³ 43 °C - 120 days
		Filtered Sediment	Adherent Gum	Total Insolubles		Std. Dev.	
				Duplicates	Mean		
A-1	480	4.1 3.3	1.3 1.3	5.4 4.6	5.0	±0.6	'trace'
A-2	-	0.4	0.5	0.9	0.9	-	-
A-3	240	1.8 1.7	1.0 0.9	2.8 2.6	2.7	±0.1	6.0
B-1	340	2.0 2.2	3.3 3.5	5.3 5.7	5.5	±0.3	1.8
B-2	300	0.4 0.6	0.9 0.6	1.3 1.2	1.3	±0.1	-
B-3	360	0.4 0.6	2.5 2.8	2.9 3.4	3.2	±0.4	1.0
C-1	420	3.1 2.7	1.0 1.2	4.1 3.9	4.0	±0.1	4.5

¹ Aged at 80 °C for 14 days or 43 °C for 120 days.² Distilled and hydrotreated shale liquids.³ Reported by Exxon as total insolubles.

Taken from Reference No. 47

TABLE 193
Insolubles from Shale I¹ and II² Fuels

A. Insolubles present in fuels before stress (mg/100 ml)					
Fuel	Filtered Sediment	Mean	Std. Dev.		
1. Shale - II DFM composite (pre-acid)	0.7 0.7	0.7	±0.0		
2. Shale - I JP - 5	0.3 0.4	0.4	±0.1		
3. Shale-I DFM	66.8				
B. Insolubles formed after stress (80 °C - 14 days)					
Fuel	Filtered Sediment	Adherent Gum	Total Insolubles		
			Duplicates	Mean	Std. Dev.
1. Shale - II DFM composite (pre-acid)	17.9 17.0	3.1 2.9	21.0 19.9	20.5	±0.8
2. Shale - I JP - 5	3.5 3.5	1.7 2.0	5.2 5.5	5.4	±0.2
3. Shale - I DFM	184.9 54.2 156.3 91.0	10.4 10.0 51.0 19.2	195.3 64.2 207.3 110.2	144.3	±68.7

¹ Obtained from the U.S. Navy Shale I program. The shale liquid was produced by a delayed coking process followed by fractionation. Both Shale I fuels contained over 1000 ppm nitrogen.

² Obtained from the U.S. Navy Shale II program, which involved hydrotreatment followed by fractionation. Although the Shale II program included acid treatment, the DFM used here was withdrawn before acid treatment.

Taken from Reference No. 47

TABLE 194

Storage Tests of Coal Liquids at 43 °C (110 °F)

Description	mg/100 mL										
	2 Weeks				4 Weeks				8 Weeks		
	Initial Existent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Existent Gum
Naphtha Unfiltered	9.3	0.3	0.6	62.3	0.3	0.5	183	0.4	1.2	186	186
Filtered	-	0.4	0.5	139	0.3	0.2	164	0.2	0.3	177	177
Naphtha Unfiltered	408	3.3	35.2	332	1.5	26.1	813	1.4	72.8	811	811
Filtered	-	3.7	34.9	676	2.6	29.0	1,277	-	-	-	-
Middle Dist. Unfiltered	17.9	0.4	0.1	133	0.3	0.1	123	1.3	0.4	282	282
Filtered	-	0.2	0.1	58.5	0.1	0.3	78	0.4	0.2	92	92
Heavy Dist. Unfiltered	20,514	-	-	13,794	-	-	14,131	-	-	-	-
Atm. Overhead Unfiltered	13	5.4	0.6	142	5.7	0.5	307	6.8	1.0	429	429
Filtered	-	0.5	0.4	118	0.2	0.4	210	0.9	0.8	351	351
Vac. Overhead Unfiltered	13,340	9.4	49.0	13,923	13.7	84.5	13,828	17.0	1.975	22,521	22,521
Filtered	-	81.5	21.0	19,673	13.1	75.6	13,232	25.0	129	17,046	17,046

Description	12 Weeks				16 Weeks				24 Weeks			
	Insoluble Precipitate	Adherent Gum	Existent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum	Insoluble Precipitate
Naphtha Unfiltered	0.2	0.6	179	-	-	-	-	-	0.1	0.5	165	0.1
Filtered	0.4	0.7	278	-	-	-	-	-	0.1	0.2	173	0.1
Naphtha Unfiltered	1.7	31	988	-	-	-	-	-	7.3	38.5	891	7.3
Middle Dist. Unfiltered	3.6	0.7	241	-	-	-	-	-	1.8	1.1	948	1.8
Filtered	0.3	0.4	139	-	-	-	-	-	0.3	0.9	151	0.3
Atm. Overhead Unfiltered	5.4	17.8	618	7.1	17.7	989	7.8	14.8	7.8	14.8	649	7.8
Filtered	3.6	3.7	536	2.8	11.4	94	0.4	0.8	0.4	0.8	389	0.4
Vac. Overhead Unfiltered	11.5	81.4	27,295	43.1	117	12,994	21.4	549	21.4	549	26,770	21.4
Filtered	12.8	110	17,943	23.4	89.4	24,372	161	814	161	814	7,126	161

Taken from Reference No. 13

TABLE 195
Kinematic Viscosity at 40 °C (104 °F) of Unaged and Aged Coal Liquids

Description	cSt		
	Unaged	Aged at 43 °C 24 weeks	Difference
Coal liquid heavy distillate - unfiltered	160.7	166.7	6.0
Coal liquid heavy distillate - filtered	152.7	168.9	16.2
Coal liquid middle distillate - unfiltered	3.19	3.27	0.08
Coal liquid middle distillate - filtered	3.44	3.46	0.02
Coal liquid vacuum overhead - unfiltered	26.19	26.03	0.16
Coal liquid vacuum overhead - filtered	25.53	1	1

1 Insufficient sample.

Taken from Reference No. 13

TABLE 196

Storage Tests of Hydrotreated Shale Syncrudes at 43 ° C (110 ° F)

Description ¹	mg/100 mL									
	2 Weeks					4 Weeks				
	Initial Existent Gum ²	Insoluble Precipitate	Adherent Gum	Existent Gum ³	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum ⁴	
Occ. HT @ 775 ° F - unfiltered	4,953	29.2	1.2	1,286	36.2	4.4	36.2	4.4	1,613	
Occ. HT @ 775 ° F - filtered	4,548	3.2	0.5	1,637	4.2	1.7	4.2	1.7	1,865	
Occ. HT @ 750 ° F - unfiltered	6,832	21.8	0.7	6,727	34.5	8.4	34.5	8.4	5,143	
Occ. HT @ 750 ° F - filtered	10,074	1.7	0.6	5,650	4.0	6.4	4.0	6.4	4,384	
Par. HT @ 700 ° F - unfiltered	29,579	23.1	1.5	22,146	27.6	1.4	27.6	1.4	19,664	
Par. HT @ 700 ° F - filtered	28,891	13.4	2.0	23,933	22.5	3.7	22.5	3.7	20,937	
Occ. HT @ 650 ° F - unfiltered	13,227	22.8	0.3	8,084	25.0	0.9	25.0	0.9	8,678	
Occ. HT @ 650 ° F - filtered	13,668	12.4	0.2	9,051	8.5	3.1	8.5	3.1	7,569	
Par. HT @ 650 ° F - unfiltered	29,361	26.8	1.2	23,805	24.5	1.7	24.5	1.7	20,435	
Par. HT @ 650 ° F - filtered	27,806	22.4	1.4	24,403	18.6	3.0	18.6	3.0	19,896	
Description	8 Weeks					16 Weeks				
	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum ³	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Adherent Gum	
	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Adherent Gum	Existent Gum ³	Insoluble Precipitate	Adherent Gum	Insoluble Precipitate	Adherent Gum	
Occ. HT @ 775 ° F - unfiltered	52.6	20.4	37.1	5.3	1,286	7.8	1.8	11.6	2.9	
Occ. HT @ 775 ° F - filtered	6.6	1.6	3.4	1.2	1,637	42.6	2.4	44.2	1.6	
Occ. HT @ 750 ° F - unfiltered	29.9	3.3	27.5	2.4	6,727	12.4	6.7	12.4	1.9	
Occ. HT @ 750 ° F - filtered	8.9	12.3	7.7	4.9	5,650	25.8	2.0	26.6	1.2	
Occ. HT @ 700 ° F - unfiltered	41.7	1.9	21.2	1.3	22,146	22.4	3.8	24.6	5.4	
Occ. HT @ 700 ° F - filtered	32.1	3.9	21.6	3.4	23,933	68.3	0.7	26.3	1.6	
Occ. HT @ 650 ° F - unfiltered	67.3	0.9	12.6	0.4	8,084	25.6	2.1	38.9	1.5	
Occ. HT @ 650 ° F - filtered	43.7	0.6	21.1	0.2	9,051	24.4	2.6	23.1	4.8	
Par. HT @ 650 ° F - unfiltered	35.6	2.2	32.0	2.0	23,805	17.5	4.3			
Par. HT @ 650 ° C - filtered	45.8	5.8	27.0	3.4	24,403					

¹ Occ. = Occidental shale oil.

Par. = Paraho shale oil.

² Determined on single 50 ml samples, evaporated for 2 hours.³ Determined on duplicate 25 ml samples evaporated for 2 hours.⁴ Determined on unfiltered, 25 ml samples evaporated for 2 hours.⁵ Insufficient sample for tests at this storage period.

Taken from Reference No. 13

TABLE 197
Summary of Storage Tests of Hydrotreated Shale Oils

Description ¹	Insoluble precipitate plus adherent gum (mg/100 mL)					
	2 Weeks	4 Weeks	8 Weeks	12 Weeks	16 Weeks	24 Weeks
Occ. HT @ 775 ° F - Unfiltered	30.4	48.6	73.0	42.4	²	²
Occ. HT @ 775 ° F - Filtered	3.7	5.9	8.2	4.6	9.6	14.5
Occ. HT @ 750 ° F - Unfiltered	22.5	43.0	33.2	29.9	45.0	45.8
Occ. HT @ 750 ° F - Filtered	2.3	10.4	21.2	12.6	19.1	14.3
Par. HT @ 700 ° F - Unfiltered	24.6	29.0	43.6	22.5	27.8	27.8
Par. HT @ 700 ° F - Filtered	15.4	26.2	36.0	25.0	26.2	30.0
Occ. HT @ 650 ° F - Unfiltered	23.1	25.9	68.2	13.0	69.0	²
Occ. HT @ 650 ° F - Filtered	12.6	11.6	44.3	21.3	27.7	27.9
Par. HT @ 650 ° F - Unfiltered	28.0	26.2	37.8	34.0	27.0	40.4
Par. HT @ 650 ° F - Filtered	23.8	21.6	51.6	30.4	21.8	27.9

¹ Occ. = Occidental shale oil

Par. = Paraho shale oil

² Insufficient sample for tests at this storage period.

Taken from Reference No. 13

TABLE 198
Heptane Insolubles in Shale Crudes, Aged at 43 ° C (110 ° F)

Description	Wt. % Insolubles						
	Unaged	2 Weeks	4 Weeks	8 Weeks	12 Weeks	16 Weeks	24 Weeks
Paraho crude unfiltered	0.48	0.23	0.17	0.13	0.13	0.14	0.19
Flask adherent insolubles	—	0.60	0.61	0.77	0.63	0.69	0.60
Total		0.83	0.78	0.90	0.76	0.83	0.79
Paraho crude filtered	0.51	0.39	0.19	0.24	0.19	0.14	0.21
Flask adherent insolubles	—	0.18	0.40	0.37	0.43	0.48	0.49
Total		0.57	0.59	0.61	0.62	0.62	0.70
Geokinetics crude unfiltered	0.41	0.42	0.40	0.40	0.38	0.38	0.48
Geokinetics crude filtered	0.41	0.42	0.47	0.40	0.43	0.43	0.50
Occidental crude unfiltered	0.37	0.52	0.40	0.47	0.47	0.45	0.56
Occidental crude filtered	0.41	0.50	0.42	0.47	0.47	0.47	0.52

in from Reference No. 13

TABLE 199

Kinematic Viscosities at 40 ° C (104 ° F) of Unaged and Aged Shale Oils

Description ²	cSt		
	Unaged	Aged at 43 ° C 24 weeks ¹	Difference Unaged-Aged
Occ. HT @ 775 ° F, unfiltered	4.80	4.92 (12 weeks)	-0.12
Occ. HT @ 775 ° F, filtered	5.01	4.92 (16 weeks)	+0.09
Occ. HT @ 750 ° F, unfiltered	7.99	7.71	+0.28
Occ. HT @ 750 ° F, filtered	7.95	7.89	+0.06
Par. HT @ 700 ° F, unfiltered	17.05	16.87	+0.38
Par. HT @ 700 ° F, filtered	16.79	16.56	+0.23
Occ. HT @ 650 ° F, unfiltered	11.59	10.99 (16 weeks)	+0.6
Occ. HT @ 650 ° F, filtered	11.25	11.33	-0.08
Par. HT @ 650 ° F, unfiltered	22.87	23.78	-0.91
Par. HT @ 650 ° F, filtered	22.13	22.60	-0.47
Par. crude, unfiltered	40.84	41.25	-0.61
Par. crude, filtered	42.06	42.15	-0.09
Geokinetics crude, unfiltered	13.91	14.17	-0.26
Geokinetics crude, filtered	14.01	13.28	+0.73
Occ. crude, unfiltered	35.63	35.11	+0.52
Occ. crude, filtered	35.20	34.51	+0.69

¹ Except where noted.² Occ. = Occidental shale oil.

Par. = Paraho shale oil.

Taken from Reference No. 13