

OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

16-21-20E

February 15, 1952

Okla Oil & Gas Company
Atlas Life Building
Tulsa, Oklahoma

Gentlemen:

Enclosed herewith is the report of the analysis of the 3" Rotary core taken from the Hunley Lease, Well No. 3-31, Anderson County, Kansas, and submitted to our laboratory on February 4, 1952.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:pc

c.c.- D.K. Auld
Garnett, Kansas

Salmon Oil Corporation
Tulsa, Oklahoma

Salmon Oil Corporation
New York 18, New York

16-21-20E
91
Hurry 5-31

OKO OIL & GAS COMPANY

CORE ANALYSIS REPORT

HUNLEY LEASE

WELL NO. S-31

ANDERSON COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

FEBRUARY 15, 1952

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Okla Oil & Gas Company Lease W. Hunley Well No. 8-31

Location NW 2

Section 16 Twp. 21S Rge. 20E County Anderson State Kansas

Name of Sand Squirrel

Top of Core 770.00

Bottom of Core 818.00

Pay
Top of Sand 773.60

Bottom of Sand 813.90

Total Feet of Permeable Sand (Analyzed) 13.42

Total Feet of Floodable Sand (Analyzed) 9.92

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

0 - 2	3.35	3.35
2 - 4	3.92	7.27
4 - 8	2.15	9.42
8 - 16	2.83	12.25
16 & above	1.17	13.42

Average Permeability Millidarcys 6.05

Average Percent Porosity 15.87

Average Percent Oil Saturation 46.09

Average Percent Water Saturation 37.85

Average Oil Content, Bbls./A. Ft. 578.

Total Oil Content, Bbls./Acre 9,259.

Average Percent Oil Recovery by Laboratory Flooding Tests 18.25

Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. 239.

Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre 2,575.

Total Calculated Oil Recovery, Bbls./Acre 2,800.

Packer Setting, Feet

Viscosity, Centipoises @

A. P. I. Gravity, degrees @ 60 °F

Elevation, Feet

1128.0

Water was used as a circulating fluid in the coring of the sand in this well.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
770.00 - 770.75	- Gray shale.
770.75 - 771.45	- Laminated sandy shale.
771.45 - 772.10	- Brown fine grained micaceous slightly shaley sandstone.
772.10 - 772.40	- Laminated shaley sandstone.
772.40 - 773.05	- Gray sandy shale.
773.05 - 773.60	- Laminated shaley sandstone.
773.60 - 774.75	- Brown fine grained micaceous sandstone.
774.75 - 775.40	- Laminated sandy shale.
775.40 - 775.75	- Laminated shaley sandstone.
775.75 - 776.20	- Laminated sandy shale.
776.20 - 776.95	- Gray sandy shale.
776.95 - 777.80	- Brown fine grained laminated micaceous shaley sandstone.
777.80 - 777.95	- Brown fine grained micaceous sandstone.
777.95 - 779.95	- Gray shale containing two sand streaks.
779.95 - 780.35	- Laminated sandy shale.
780.35 - 781.35	- Gray shale.
781.35 - 782.00	- Laminated sandy shale.
782.00 - 782.40	- Brown fine grained slightly laminated micaceous shaley sandstone.
782.40 - 782.70	- Laminated sandy shale.
782.70 - 783.10	- Brown fine grained laminated micaceous shaley sandstone.
783.10 - 783.40	- Gray shale.

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- 783.40 - 783.55 - Laminated sandstone and shale.
- 783.55 - 783.70 - Brown fine grained micaceous sandstone.
- 783.70 - 784.20 - Laminated shaley sandstone.
- 784.20 - 784.55 - Gray shale.
- 784.55 - 784.85 - Laminated shale and sandstone.
- 784.85 - 786.15 - Laminated sandy shale.
- 786.15 - 786.90 - Finely laminated sandstone and shale.
- 786.90 - 787.35 - Laminated shale and sandstone.
- 787.35 - 787.78 - Brown fine grained micaceous sandstone.
- 787.78 - 788.55 - Laminated sandy shale.
- 788.55 - 789.57 - Brown fine grained laminated micaceous shaley sandstone.
- 789.57 - 789.85 - Laminated sandy shale.
- 789.85 - 790.15 - Brown fine grained slightly laminated micaceous shaley sandstone.
- 790.15 - 790.30 - Finely laminated sandy shale.
- 790.30 - 790.60 - Finely laminated shale and sandstone.
- 790.60 - 790.80 - Finely laminated sandy shale.
- 790.80 - 791.10 - Laminated shaley sandstone.
- 791.10 - 791.70 - Laminated sandy shale.
- 791.70 - 792.10 - Brown fine grained laminated micaceous shaley sandstone.
- 792.10 - 792.60 - Brown fine grained slightly laminated micaceous shaley sandstone.
- 792.60 - 794.62 - Brown fine grained micaceous sandstone.
- 794.62 - 795.00 - Gray shale.
- 795.00 - 795.30 - Brown fine grained micaceous sandstone.
- 795.30 - 796.20 - Gray shale.
- 796.20 - 796.50 - Gray sandy shale.
- 796.50 - 798.40 - Gray shale.

- 798.40 - 801.10 - Laminated sandy shale.
- 801.10 - 801.55 - Laminated shale and sandstone.
- 801.55 - 801.95 - Brown fine grained laminated micaceous shaley sandstone.
- 801.95 - 802.35 - Finely laminated shaley sandstone.
- 802.35 - 804.90 - Gray sandy shale.
- 804.90 - 805.30 - Brown fine grained laminated micaceous shaley sandstone.
- 805.30 - 809.90 - Gray shale.
- 809.90 - 810.65 - Laminated sandstone and shale.
- 810.65 - 811.22 - Brown fine grained micaceous sandstone.
- 811.22 - 811.42 - Gray shale.
- 811.42 - 812.30 - Brown fine grained micaceous slightly calcareous sandstone.
- 812.30 - 812.60 - Brown fine grained slightly laminated micaceous shaley sandstone.
- 812.60 - 813.90 - Brown fine grained micaceous sandstone.
- 813.90 - 814.80 - Gray shale.
- 814.80 - 815.40 - Gray calcareous fossiliferous shale.
- 815.40 - 817.00 - Black shale.
- 817.00 - 818.00 - Discarded at well.

Coring was started at a depth of 770.00 feet in gray shale and completed at 818.00 feet probably in shale. The bottom foot was discarded at well. This core shows a total of 16.57 feet of formation containing oil. For the most part, the pay is made up of fine grained micaceous to shaley sandstone. The cored section is badly broken by layers of shale and laminated sandstone and shale.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and

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lower sections is 3.02, 16.21 and 5.95 millidarcys respectively; the overall average being 6.05 (See Table II). By observing the data given on the coregraph, it is noticeable that the cored section has a very irregular permeability profile and is comparatively tight.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 46.09. The weighted average percent oil saturation of the upper, middle and lower sections is 44.14, 48.19 and 49.47 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 41.51, 27.93 and 34.88 respectively; the overall average being 37.85 (See Table IV). This gives an overall weighted average total fluid saturation of 83.94 percent. This fairly low total fluid saturation indicates that an appreciable amount of fluid was lost during coring which was probably oil.

In an effort to determine the degree of flushing of the sand during coring, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VII and VIII. From the data given in these tables and on the coregraph, it is evident that the water used as a circulating fluid was fairly salty as the chloride content of the sand is comparatively uniform.

The weighted average oil content of the upper, middle and lower sections is 541, 666 and 612 barrels per acre foot respectively; the overall average being 578. The total oil content, as shown by this core, is 9,259 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

The sand in this core responded very well to laboratory flooding

tests, as a total recovery of 2,575 barrels of oil per acre was obtained from 10.77 feet of sand. The weighted average percent oil saturation was reduced from 48.48 to 30.23 or represents an average recovery of 18.25 percent. The weighted average effective permeability of the samples is 0.344 millidarcys, while the average initial fluid production pressure is 35.0 pounds per square inch (See Table VI).

From the data given in Table V, you will note that of the 24 samples tested, 14 produced water and 14 oil. This indicates that approximately 58 percent of the sand represented by these samples is floodable. The tests also show that the sand is comparatively tight and rather high pressures were required to force the sand to take water.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 2,800 barrels of oil per acre, or an average of 282 barrels per acre foot from the 9.92 feet of floodable sand analyzed provided all of this sand will take water satisfactorily. In calculating this recovery, an allowance was made for oil lost during coring, and it was assumed that the primary production and the true water saturation of the sand are 10 and 30 percent respectively. Chances are, considerable additional oil can be recovered by using proper selective plugging in the later stages of the flood in order to shut off the more permeable zones and, thereby, making it possible to get more water into the tighter sand.

The principle drawback of this core is the fact that it contains only approximately 10 feet of floodable sand.

Oil Field Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company Oko Oil & Gas Company Lease Hunley Well No. S-31

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	771.20	Imp.	0.70	0.70	0.00
2	771.82	3.7	0.65	1.35	2.41
3	772.28	Imp.	0.30	1.65	0.00
4	773.22	0.46	0.55	2.20	0.25
5	773.70	5.6	0.30	2.50	1.68
6	774.10	10.	0.40	2.90	4.00
7	774.67	1.7	0.45	3.35	0.77
8	775.64	Imp.	0.35	3.70	0.00
9	776.07	Imp.	0.45	4.15	0.00
10	777.32	0.40	0.85	5.00	0.34
11	777.90	1.9	0.15	5.15	0.29
12	779.05	1.3	0.10	5.25	0.13
13	780.05	Imp.	0.40	5.65	0.00
14	781.90	Imp.	0.65	6.30	0.00
15	782.35	8.0	0.40	6.70	3.20
16	782.95	3.4	0.40	7.10	1.36
17	783.75	1.1	0.50	7.60	0.55
18	784.70	Imp.	0.30	7.90	0.00
19	786.55	Imp.	0.75	8.65	0.00
20	787.22	1.9	0.45	9.10	0.86
21	787.73	4.1	0.43	9.53	1.76
22	788.63	3.9	0.45	9.98	1.76
23	789.25	2.5	0.57	10.55	1.43
24	790.00	1.4	0.30	10.85	0.42
25	791.00	2.4	0.30	11.15	0.72
26	792.00	2.9	0.40	11.55	1.16
27	792.66	9.7	0.30	11.85	2.91
28	793.10	22.	0.50	12.35	11.00
29	793.70	15.	0.40	12.75	6.00
30	793.99	12.	0.45	13.20	5.40
31	794.50	17.	0.37	13.57	6.29
32	795.15	20.	0.30	13.87	6.00
33	801.15	Imp.	0.45	14.32	0.00
34	801.65	2.1	0.20	14.52	0.42
35	801.85	2.7	0.20	14.72	0.54
36	804.93	Imp.	0.40	15.12	0.00
37	810.98	5.7	0.57	15.69	3.25
38	811.46	15.	0.38	16.07	5.70
39	812.06	8.4	0.50	16.57	4.20
40	812.40	2.2	0.30	16.87	0.66
41	812.83	5.2	0.45	17.32	2.34
42	813.30	2.2	0.45	17.77	0.99
43	813.74	6.1	0.40	18.17	2.44

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company **Oko Oil & Gas Company** Lease **W. Hunley** Well No. **8-31**

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
770.75 - 792.10	7.65	3.02	23.09
792.60 - 795.30	2.32	16.21	37.60
801.10 - 813.90	3.45	5.95	20.54
770.75 - 813.90	13.42	6.05	81.23

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company **Oko Oil & Gas Company**

Lease **W. Hunley**

S-31

Well No.

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content, Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1	771.60	17.5	42.0	32.0	74.0	570	0.65	0.65	371
2	773.45	13.2	33.7	57.0	90.7	445	0.55	1.20	245
3	774.50	17.4	53.1	27.2	80.3	717	1.15	2.35	825
4	775.86	11.8	25.1	69.2	94.3	230	0.45	2.80	104
5	777.65	15.2	56.5	34.6	91.1	666	0.85	3.65	566
7	782.15	16.3	42.5	34.8	77.5	507	0.40	4.05	203
8	783.48	13.8	42.3	53.6	95.9	453	0.15	4.20	68
7-8	783.62	15.7	45.3	-	-	553	0.15	4.35	83
9	784.70	13.7	46.0	47.0	93.0	490	0.30	4.65	147
10	786.30	13.9	39.1	50.0	89.1	422	1.20	5.85	506
11	787.50	17.2	45.9	30.5	76.4	614	0.43	6.28	264
12	788.85	16.0	43.9	41.1	85.0	547	1.02	7.30	558
13	790.00	16.9	54.6	31.8	86.4	717	0.30	7.60	215
14	791.25	13.2	35.8	57.8	93.6	368	0.90	8.50	331
15	792.25	17.2	49.6	30.2	79.8	664	0.90	9.40	598
16	793.35	17.5	48.7	27.0	75.7	662	1.20	10.60	794

RESULTS OF SATURATION TESTS

TABLE III

id. Hunley

Lease-

Well No.:

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Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content, Bbbs./A. Ft.	Feet of Core		Total Oil Content Bbbs./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
17	794.25	18.2	51.1	25.6	76.7	722	0.82	11.42	592
18	795.15	18.0	37.6	37.9	75.5	526	0.30	11.72	158
21	801.40	14.8	37.8	44.5	82.3	434	0.45	12.17	195
22	802.10	15.7	39.5	44.0	83.5	481	0.40	12.57	192
24	805.15	15.6	52.5	33.9	86.4	637	0.40	12.97	255
25	810.80	18.1	59.8	27.1	86.9	843	0.57	13.54	481
26	811.85	16.0	46.8	31.4	77.4	571	0.88	14.42	502
27	812.51	13.8	37.7	49.0	86.7	405	0.30	14.72	122
P-27	812.68	16.8	55.8	-	-	729	0.65	15.37	474
28	813.45	14.7	55.3	27.8	83.1	631	0.65	16.02	410
							Total -	- - - -	- - 9,259

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company	Okro Oil & Gas Company	Lease	W. Hunley	Well No.	S-31	
Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
771.45-792.60	9.40	15.39	44.14	41.51	541	5,084
792.60-795.30	2.32	17.80	48.19	27.93	666	1,544
801.10-813.90	4.30	15.86	49.47	34.88	612	2,631
771.45-813.90	16.02	15.87	46.09	37.85	578	9,259

Oil Field Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Okco Oil & Gas Company Lease Hunley Well No. 3-31

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	771.60	17.3	40.1	344	9.6	130	30.5	68.9	414	34	0.320	35
2	773.45	13.3	38.8	368	0.0	0	35.6	59.4	368	0	Imp.	50 ~~+~~
3	774.50	17.4	50.2	378	22.6	303	27.6	60.0	373	20	0.292	30
4	775.86	12.7	21.0	207	0.0	0	21.0	70.0	207	0	Imp.	50 ~~+~~
5	777.65	15.3	54.1	642	20.4	242	33.7	60.0	400	0	0.006	50
7	782.15	16.5	43.8	559	11.7	150	31.9	61.7	409	11	0.152	33
8	783.82	15.7	45.3	552	0.0	0	45.3	59.2	552	0	Imp.	50 ~~+~~
9	784.70	13.8	45.5	466	0.0	0	45.5	50.7	466	0	Imp.	50 ~~+~~
10	786.30	13.2	41.1	421	0.0	0	41.1	55.8	421	0	Imp.	50 ~~+~~
11	787.50	16.9	43.5	610	10.9	142	35.7	59.4	468	3	0.095	50
12	788.85	16.3	42.5	543	9.1	117	33.4	63.8	428	7	0.148	45
13	790.00	16.8	53.1	682	16.7	213	36.4	66.7	474	3	0.044	50
14	791.55	14.0	34.5	375	0.0	0	34.5	61.8	375	0	Imp.	50 ~~+~~
15	792.25	17.6	48.0	657	13.5	183	34.5	62.3	472	8	0.155	45
16	793.35	18.0	45.7	636	15.5	216	30.2	65.3	422	56	0.625	30
17	794.25	18.3	49.3	702	21.6	306	27.9	63.7	396	100	0.546	30
18	795.15	16.0	36.4	508	10.6	148	25.8	68.0	360	64	0.684	50
21	801.40	14.9	34.1	394	0.0	0	34.1	55.6	394	0	Imp.	50 ~~+~~
22	802.10	15.8	41.0	503	0.0	0	41.0	56.0	503	0	Imp.	50 ~~+~~
24	806.15	15.9	50.9	628	0.0	0	50.9	42.0	628	0	Imp.	50 ~~+~~
25	810.80	16.0	57.8	807	29.6	413	28.2	66.3	394	30	0.594	25
26	811.85	15.9	46.3	559	19.7	243	25.6	69.0	316	28	0.610	25
27	812.51	16.8	55.8	727	28.4	370	27.4	64.3	357	13	0.292	20
28	813.45	14.5	57.4	647	29.6	336	27.6	60.2	311	8	0.177	25

Notes: cc - cubic centimeter
* - Volume of water recovered at the time of maximum oil recovery.
** - Determined by passing water through sample which still contains residual oil.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company	Okio Oil & Gas Company	Lease	Hunley	Well No.	S-31
Depth Interval, Feet	771.45	792.60	810.65	771.45	813.90
Feet of Core Analyzed	792.60	795.30	813.90	813.90	813.90
Average Percent Porosity	5.70	2.32	2.75	10.77	16.95
Average Percent Original Oil Saturation	16.86	18.10	16.16	16.95	48.48
Average Percent Oil Recovery	47.16	45.60	53.24	48.48	18.25
Average Percent Residual Oil Saturation	14.98	16.81	26.22	18.25	30.23
Average Percent Residual Water Saturation	32.18	28.79	27.02	63.40	93.63
Average Percent Total Residual Fluid Saturation	61.79	64.83	65.49	93.63	636.
Average Original Oil Content, Bbls./A. Ft.	93.97	93.62	92.51	636.	239.
Average Oil Recovery, Bbls./A. Ft.	617.	643.	670.	239.	397.
Average Residual Oil Content, Bbls./A. Ft.	195.	239.	330.	397.	6,855.
Total Original Oil Content, Bbls./Acre	422.	404.	340.	6,855.	2,575.
Total Oil Recovery, Bbls./Acre	3,520.	1,492.	1,843.	4,280.	0.344
Total Residual Oil Content, Bbls./Acre	1,114.	554.	907.	0.344	35.0
Average Effective Permeability, Millidarcys	2,406.	938.	936.	35.0	
Average Initial Fluid Production Pressure, p.s.i.	0.173	0.664	0.429		
	42.5	30.0	23.1		

NOTE: Only those samples which recovered oil were used in calculating the above averages.

Oil Field Research Laboratories
RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VII

Company Okla Oil & Gas Company Lease Hunley Well No. S-31

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		Total
			Connate	Drilling & Foreign	
1	771.60	14,000			
2	773.45	17,800			
3	774.50	19,900			
4	775.86	16,600			
5	777.65	16,900			
7	782.15	19,500			
8	783.48	15,600			
9	784.70	19,200			
10	786.30	21,400			
11	787.50	21,100			
12	788.85	18,500			
13	790.00	16,700			
14	791.25	20,900			
15	792.25	21,200			
16	793.35	16,700			
17	794.25	19,800			
18	795.15	17,000			
21	801.40	19,400			
22	802.10	20,000			
24	805.15	16,800			
25	810.80	19,000			
26	811.85	19,000			
27	812.51	20,900			
28	813.45	20,000			
Note: ppm - parts per million.					

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Oke Oil & Gas Company Lease W. Hunley Well No. 8-31

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
771.45 - 792.60	12,029		
792.60 - 795.30	17,845		
801.10 - 813.90	18,723		
771.45 - 813.90	18,775		

Note: ppm - parts per million.