

OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

January 13, 1951

The Ohio Oil Company
Thompson Building
Tulsa, Oklahoma

Attention: Mr. R. E. McMillen

Gentlemen:

Enclosed herewith is the report of the analysis of the 2½" rotary core taken from the Atyeo "A" Lease, Well No. W-16, Lyon County, Kansas, and submitted to our laboratory on December 18, 1950.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:mm

c.c. to Mr. H. A. Scott

30-21-10E

W-16

"A"

Atyeo

THE OHIO OIL COMPANY

CORE ANALYSIS REPORT

ATYEO "A" LEASE

WELL NO. W-16

LYON COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

JANUARY 13, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company The Ohio Oil Company Lease Atyeo "A" Well No. W-16

Location _____

Section 30 Twp. 21 S Rge. 10 E County Lyon State Kansas

Name of Sand	Bartlesville
Top of Core	2127.00
Bottom of Core	2150.00
Top of Sand	?
Bottom of Sand	2148.90
Total Feet of Permeable Sand	19.32

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

0 - 5	5.97	5.97
5 - 10	4.35	10.32
10 - 20	2.25	12.57
20 - 30	1.95	14.52
30 - 40	2.35	16.87
40 - 100	1.50	18.37
100 & above	0.95	19.32

Average Permeability Millidarcys	25.57
Average Percent Porosity	17.14
Average Percent Oil Saturation	25.32
Average Percent Water Saturation	60.15
Average Oil Content, Bbls./A. Ft.	342.
Total Oil Content, Bbls./Acre	6,517.
Average Percent Oil Recovery by Laboratory Flooding Tests	410.
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	58.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	740.
Total Calculated Oil Recovery, Bbls./Acre	1,100.
Casing Point	
~~Permeability~~ , Feet	2123.
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	

-2-

Fresh water was used in making up the circulating fluid used 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>
2127.00 - 2127.30	- Light brown medium grained finely laminated micaceous carbonaceous sandstone.
2127.30 - 2128.50	- Light brown medium grained slightly laminated micaceous carbonaceous sandstone.
2128.50 - 2131.55	- Light brown medium grained micaceous sandstone.
2131.55 - 2131.85	- Light brown medium grained slightly laminated micaceous carbonaceous sandstone.
2131.85 - 2132.35	- Light brown medium grained micaceous sandstone.
2132.35 - 2132.70	- Light brown medium grained micaceous carbonaceous sandstone.
2132.70 - 2134.60	- Light brown medium grained micaceous sandstone.
2134.60 - 2136.00	- Light brown medium grained micaceous slightly calcareous sandstone.
2136.00 - 2137.00	- Loss (according to log, sandstone).
2137.00 - 2137.75	- Light brown medium grained micaceous sandstone.
2137.75 - 2139.45	- Brown medium grained micaceous sandstone.
2139.45 - 2139.65	- Light brown medium grained micaceous carbonaceous sandstone.
2139.65 - 2139.75	- Coal.
2139.75 - 2140.00	- Gray sandy shale.
2140.00 - 2141.43	- Light brown fine grained micaceous sandstone.
2141.43 - 2141.75	- Light brown fine grained micaceous slightly shaley sandstone.
2141.75 - 2141.95	- Light brown fine grained micaceous conglomeratic sandstone.

- 2141.95 - 2142.05 - Gray sandy shale.
2142.05 - 2142.88 - Sandy conglomerate.
2142.88 - 2143.00 - Light brown fine grained micaceous conglomeratic sandstone.
2143.00 - 2143.45 - Sandy conglomerate.
2143.45 - 2146.30 - Light brown fine grained micaceous sandstone.
2146.30 - 2146.50 - Light brown fine grained finely laminated micaceous carbonaceous sandstone.
2146.50 - 2148.90 - Light brown fine grained micaceous sandstone.
2148.90 - 2149.00 - Black shale.
2149.00 - 2150.00 - Discarded at well.

Coring was started at a depth of 2127.00 feet in medium grained slightly laminated micaceous carbonaceous sandstone and completed at 2150.00 feet; probably in shale. That part of the cored section extending from 2149.00 to 2150.00 feet was discarded at well. This core shows a total of 20.33 feet of sandstone. There was a loss extending from 2136.00 to 2137.00 feet which was probably sandstone. For the most part, the pay sand is made up of fine to medium grained micaceous sandstone. There is a thin coal layer extending from 2139.65 to 2139.75 feet.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are 22.08 and 28.91 millidarcys respectively; the overall average being 25.57 (See Table II). By observing the data given in Table I and on the coregraph, it is noticeable that the sand has a very wide variation in permeability. There was a very loose streak extending from 2157.00 to 2158.90 feet.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 25.32. The weighted average percent oil saturation of the upper and lower sections are 21.46 and 28.85 respectively. The weighted average percent water saturation of the upper and lower sections are 64.80 and 55.90 respectively; the overall average being 60.15 (See Table IV). This gives an overall weighted average total fluid saturation of 85.47 percent.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analyzed for chloride content which in turn were used in the determination of percent connate water saturation. The results of these tests are given in Tables VII and VIII. By observing the data given in these tables and on the coregraph, it is evident that considerable flushing of the sand did occur during coring as, for the most part, the zones of higher permeability have the lower chloride content.

The weighted average oil content of the upper and lower sections are 287 and 391 barrels per acre foot respectively; the overall average being 342. The total oil content, as shown by this core, is 6,517 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

Inasmuch as the sand in this core has a low weighted average percent oil saturation, naturally one would expect very little oil to be recovered by laboratory flooding tests. A total recovery of 740 barrels of oil per acre was obtained from 12.65 feet of sand. The weighted average percent oil saturation was reduced from 25.90 to 21.80, or

represents an average recovery of 4.1 percent. The weighted average effective permeability of the samples is 5.00 millidarcys while the average initial fluid production pressure is 23.0 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 22 samples tested, 17 produced water and 15 oil. This shows that part of the sand is not floodable. The tests also show that the sand has a wide variation in effective permeability.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 1,100 barrels of oil per acre or an average of 110 barrels per acre foot. In calculating this recovery, an allowance was made for oil lost during coring and it was assumed that the true water saturation of the sand is 40 percent. Chances are the recovery for the sand within the vicinity of this well could be increased by using proper selective plugging in the later stages of the flood.

The principle drawback of this core is the fact that the sand has a wide variation in permeability and as a result the lower zones will have a tendency to take most of the water. There is also a thin coal streak in the sand section, however, it is doubtful whether it is of sufficient thickness to cause any trouble. The core shows a total of 10.0 feet of good floodable sand.

Oil Field Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company The Ohio Oil Company Lease Atyeo "A" Well No. W-16

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	2127.21	1.6	0.30	0.30	0.48
2	2127.70	32.	0.60	0.90	19.20
3	2128.10	26.	0.35	1.25	9.10
4	2128.45	4.0	0.45	1.70	1.80
5	2128.90	9.6	0.40	2.10	3.84
6	2129.35	3.7	0.45	2.55	1.67
7	2129.76	2.6	0.50	3.05	1.30
8	2130.34	4.7	0.55	3.60	2.59
9	2130.80	2.0	0.40	4.00	0.80
10	2131.10	4.7	0.30	4.30	1.41
11	2131.44	3.9	0.25	4.55	0.98
12	2131.91	4.9	0.25	4.80	1.23
13	2132.25	7.8	0.25	5.05	1.95
14	2132.62	1.3	0.35	5.40	0.46
15	2133.10	83.	0.60	6.00	49.80
16	2133.55	26.	0.45	6.45	11.70
17	2134.00	3.0	0.50	6.95	1.50
18	2134.50	14.	0.35	7.30	4.90
19	2135.00	7.4	0.50	7.80	3.70
20	2135.30	3.9	0.40	8.20	1.56
21	2135.80	33.	0.50	8.70	16.50
22	2137.10	141.	0.40	9.10	56.40
23	2137.65	45.	0.35	9.45	15.75
24	2138.06	229.	0.55	10.00	125.95
25	2138.60	61.	0.55	10.55	33.55
26	2139.10	25.	0.60	11.15	15.00
27	2139.52	18.	0.20	11.35	3.60
28	2140.34	9.5	0.50	11.85	4.75
29	2140.71	8.5	0.40	12.25	3.40
30	2141.10	6.0	0.53	12.78	3.18
31	2141.50	9.9	0.32	13.10	3.17
32	2141.84	15.	0.20	13.30	3.00
33	2142.64	Imp.	0.83	14.13	0.00
34	2142.95	1.8	0.12	14.25	0.22
35	2143.26	1.8	0.45	14.70	0.81
36	2143.55	4.7	0.30	15.00	1.41
37	2143.93	8.3	0.45	15.45	3.74
38	2144.40	14.	0.30	15.75	4.20
39	2144.65	11.	0.35	16.10	3.85
40	2145.05	8.8	0.40	16.50	3.52

Oil Field Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company The Ohio Oil Company Lease Atyeo "A" Well No. W-16

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	2145.40	12.	0.25	16.75	3.00
42	2145.65	12.	0.40	17.15	4.80
43	2146.10	0.85	0.40	17.55	0.34
44	2146.45	10.	0.20	17.75	2.00
45	2146.87	8.6	0.60	18.35	5.16
46	2147.35	33.	0.40	18.75	13.20
47	2147.75	38.	0.45	19.20	17.10
48	2148.13	37.	0.40	19.60	14.80
49	2148.54	21.	0.55	20.15	11.55

Oil Field Research Laboratories
SUMMARY OF PERMEABILITY TESTS

TABLE II

Company The Ohio Oil Company Lease Atyco "A" Well No. W-16

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
2127.00 - 2137.75	9.45	22.08	208.62
2137.75 - 2148.90	9.87	28.91	285.30
2127.00 - 2148.90	19.32	25.57	493.92

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company The Ohio Oil Company Lease Atyeo "A" Well No. W-16

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	2127.52	16.5	20.6	60.4	81.0	264	1.20	1.20	317
2	2128.73	16.3	20.9	69.1	90.0	346	0.70	1.90	242
3	2129.63	15.9	21.3	64.8	86.1	263	1.00	2.90	263
4	2130.68	16.5	20.9	62.1	83.0	268	1.35	4.25	362
5	2131.76	14.8	18.5	65.2	83.7	212	0.80	5.05	170
6	2132.92	18.5	19.1	63.4	82.5	274	0.60	5.65	164
7	2133.88	18.1	25.6	68.9	94.5	360	1.30	6.95	468
8	2134.82	14.9	22.9	75.5	98.4	265	0.60	7.55	159
9	2135.67	17.8	25.0	57.4	82.4	345	0.80	8.35	276
10	2137.48	18.8	17.4	66.0	83.4	254	0.75	9.10	191
11	2138.43	19.8	28.3	65.7	94.0	435	1.10	10.20	479
12	2139.38	18.8	29.8	58.3	88.1	435	0.60	10.80	261
13	2140.22	18.2	30.2	46.6	76.8	426	1.43	12.23	610
14	2141.70	17.2	26.3	46.7	73.0	351	0.32	12.55	112
15	2142.27	11.0	31.0	65.5	96.5	264	0.83	13.38	220
16	2143.15	11.7	26.7	63.3	90.0	243	0.45	13.83	109
17	2144.24	18.2	31.8	51.1	82.9	449	1.15	14.98	516
18	2144.93	18.1	27.9	56.0	83.9	414	0.80	15.78	331
19	2145.92	16.3	30.3	58.7	89.0	383	0.90	16.68	345
20	2146.73	18.6	26.8	57.7	84.5	387	0.60	17.28	232
21	2147.62	19.1	25.4	51.4	76.8	376	1.10	18.38	414
22	2148.82	18.4	27.7	55.0	82.7	395	0.70	19.08	276
							Total	- - -	6,517

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company The Ohio Oil Company Lease Atyeo "A" Well No. W-16

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
2127.30-2137.75	9.10	16.82	21.46	64.80	287	2,612
2137.75-2148.90	9.98	17.44	28.85	55.90	391	3,905
2127.30-2148.90	19.08	17.14	25.32	60.15	342	6,517

Oil Field Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company The Ohio Oil Company

Lease Atyeo "A"

Well No. W-16

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	Bbbs./A. Ft.	Percent	Bbbs./A. Ft.	% Oil	% Water	Bbbs./A. Ft.			
1	2127.36	16.0	22.1	274	0.0	0	22.1	61.0	274	0	Imp.	50+
2	2128.55	17.0	19.5	258	3.4	45	16.1	72.2	213	20	0.590	35
3	2129.45	15.6	20.2	245	0.0	0	20.2	74.0	245	0	Imp.	50+
4	2130.53	15.4	22.6	270	0.0	0	22.6	62.1	270	0	Imp.	50+
5	2131.62	14.3	20.1	223	0.0	0	20.1	69.2	223	0	Imp.	50+
6	2132.76	18.3	19.7	280	4.4	63	15.3	70.7	217	121	6.19	10
7	2133.73	18.8	23.7	346	2.5	36	21.2	72.6	310	152	8.66	10
8	2134.65	14.7	23.4	267	2.0	23	21.4	71.5	244	8	0.242	35
9	2135.53	17.7	24.1	331	0.0	0	24.1	59.5	331	33	0.670	20
10	2137.31	18.9	17.0	250	0.8	12	16.2	75.2	238	151	24.65	5
11	2138.26	19.6	28.8	338	10.8	164	18.0	64.7	274	198	19.29	5
12	2139.22	19.0	29.3	432	11.1	164	18.2	62.5	268	20	0.475	20
13	2140.05	18.2	29.8	421	1.0	14	28.8	61.7	407	7	0.145	35
14	2141.60	17.1	27.0	359	4.0	53	23.0	62.4	306	1	0.095	40
15	2142.12	10.9	31.9	270	0.0	0	31.9	59.4	270	0	Imp.	50+
16	2143.05	11.5	27.4	245	0.0	0	27.4	60.3	245	1	0.033	50
17	2144.05	18.1	30.7	431	6.7	94	24.0	66.1	337	18	0.425	25
18	2144.75	18.1	27.4	385	4.4	62	23.0	63.7	323	13	0.350	30
19	2145.75	16.8	28.8	375	4.7	61	24.1	63.9	314	6	0.183	35
20	2146.56	18.6	26.9	389	2.3	33	24.6	63.0	356	23	0.520	25
21	2147.45	19.1	24.1	357	2.1	31	22.0	67.5	326	98	3.61	20
22	2148.65	18.9	26.1	383	2.0	29	24.1	64.9	354	96	3.20	15

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	The Ohio Oil Company		Lease	Atyeo "A"		Well No.	W-16	
Depth Interval, Feet	2128.50 - 2137.75		2137.75 - 2148.90		2128.50 - 2148.90			
Feet of Core Analyzed	3.95		8.70		12.65			
Average Percent Porosity	17.81		18.42		18.23			
Average Percent Original Oil Saturation	21.03		28.11		25.90			
Average Percent Oil Recovery	2.55		4.80		4.10			
Average Percent Residual Oil Saturation	18.48		23.31		21.80			
Average Percent Residual Water Saturation	72.60		64.22		66.84			
Average Percent Total Residual Fluid Saturation	91.08		87.53		88.64			
Average Original Oil Content, Bbls./A. Ft.	298.		400.		368.			
Average Oil Recovery, Bbls./A. Ft.	35.		69.		58.			
Average Residual Oil Content, Bbls./A. Ft.	263.		331.		310.			
Total Original Oil Content, Bbls./Acre	1,178.		3,480.		4,658.			
Total Oil Recovery, Bbls./Acre	140.		600.		740.			
Total Residual Oil Content, Bbls./Acre	1,038.		2,880.		3,918.			
Average Effective Permeability, Millidarcys	8.61		3.36		5.00			
Average Initial Fluid Production Pressure, p.s.i.	19.0		25.0		23.0			

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 The Ohio Oil Company Lease Atyeo "A" Well No. W-16

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Connate	Percent Water Saturation Drilling & Foreign	Total
1	2127.52	51,700	47.9	12.5	60.4
2	2128.73	46,600	49.5	19.6	69.1
3	2129.63	47,600	47.4	17.4	64.8
4	2130.68	58,300	55.7	6.4	62.1
5	2131.76	50,300	50.5	14.7	65.2
6	2132.92	26,200	25.5	37.9	63.4
7	2133.88	7,900	8.4	60.5	68.9
8	2134.82	8,100	9.4	66.1	75.5
9	2135.67	18,500	16.3	41.1	57.4
10	2137.48	3,900	4.0	62.0	66.0
11	2138.43	5,300	5.4	60.3	65.7
12	2139.38	41,800	37.5	20.8	58.3
13	2140.22	51,900	37.2	9.4	46.6
14	2141.70	47,000	34.0	12.7	46.7
15	2142.27	50,600	51.0	14.5	65.5
16	2143.15	46,900	45.7	17.6	63.3
17	2144.24	54,100	42.5	8.6	51.1
18	2144.93	44,500	38.3	17.7	56.0
19	2145.92	49,800	45.0	13.7	58.7
20	2146.73	41,300	36.7	21.0	57.7
21	2147.62	13,900	11.0	40.4	51.4
22	2148.82	24,700	20.9	34.1	55.0
Note: ppm - parts per million					

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company	The Ohio Oil Company	Lease	Atyeo "A"	Well No.	W-16
Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water		
2127.30 - 2137.75	34,044	33.31	31.54		
2137.75 - 2148.90	38,407	32.48	23.41		
2127.30 - 2148.90	36,326	32.88	27.29		

Note: ppm - parts per million