

OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

March 12, 1951

The Ohio Oil Company
Thompson Building
Tulsa, Oklahoma

Attention: Mr. Fred Kluck

Gentlemen:

Enclosed herewith is the report of the analysis of the 2 $\frac{1}{8}$ " Rotary core taken from the Martindell Lease, Well No. 43, Greenwood County, Kansas, and submitted to our laboratory on February 27, 1951.

Very turly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:pmd

THE OHIO OIL COMPANY

CORE ANALYSIS REPORT

MARTINDELL LEASE

WELL NO. 43

GREENWOOD COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

MARCH 12, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company The Ohio Oil Company Lease Martindell Well No. 43

Location _____

Section 31 Twp. 23 Rge. 10 County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2342.00
Bottom of Core	2376.00
Top of Sand (According to strip log)	2338.00
Bottom of Sand (According to strip log)	2365.00
Total Feet of Permeable Sand	18.66

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

	Feet	Cum. Ft.
0 - 1	3.18	3.18
1 - 2	5.98	9.16
2 - 4	4.08	13.24
4 - 8	1.42	14.66
8 & above	4.00	18.66

Average Permeability Millidarcys	4.25
Average Percent Porosity	14.46
Average Percent Oil Saturation	26.94
Average Percent Water Saturation	50.15
Average Oil Content, Bbls./A. Ft.	302.
Total Oil Content, Bbls./Acre	5,366.
Average Percent Oil Recovery by Laboratory Flooding Tests	2.64
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	31.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	44.
Total Calculated Oil Recovery, Bbls./Acre	900.
Casing Point (5 $\frac{1}{2}$ ")	
Packer Setting, Feet	2331.00
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation	1409.0

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>
2342.00 - 2343.60	- Light brown fine grained micaceous sandstone.
2343.60 - 2345.75	- Light brown fine grained laminated micaceous carbonaceous sandstone.
2345.75 - 2346.60	- Light brown fine grained micaceous sandstone.
2346.60 - 2346.80	- Light brown fine grained micaceous shaley sandstone.
2346.80 - 2347.80	- Light brown very fine grained micaceous sandstone.
2347.80 - 2349.70	- Light brown fine grained micaceous sandstone.
2349.70 - 2349.90	- Light brown fine grained finely laminated micaceous carbonaceous sandstone.
2349.90 - 2350.08	- Light brown fine grained micaceous calcareous sandstone containing a vertical fracture.
2350.08 - 2350.32	- Light brown fine grained finely laminated micaceous carbonaceous calcareous sandstone containing a vertical fracture.
2350.32 - 2351.00	- Light brown fine grained micaceous calcareous sandstone containing a vertical fracture.
2351.00 - 2355.90	- Light brown fine grained micaceous sandstone.
2355.90 - 2357.23	- Light brown fine grained micaceous calcareous sandstone.
2357.23 - 2360.80	- Light brown fine grained micaceous sandstone.
2360.80 - 2361.00	- Light brown fine grained slightly laminated micaceous carbonaceous sandstone.
2361.00 - 2361.33	- Light brown fine grained micaceous sandstone.
2361.33 - 2361.43	- Light brown fine grained laminated micaceous carbonaceous sandstone.
2361.43 - 2362.00	- Light brown fine grained micaceous slightly calcareous sandstone.

- 2362.00 - 2365.00 - Loss, according to log, sand.
- 2365.00 - 2366.00 - Sandy shale.
- 2366.00 - 2366.90 - Finely laminated sandstone and shale containing a vertical fracture.
- 2366.90 - 2367.05 - Gray shale containing a vertical fracture.
- 2367.05 - 2368.70 - Finely laminated shale and sandstone containing a vertical fracture.
- 2368.70 - 2370.30 - Finely laminated sandstone and shale containing a vertical fracture.
- 2370.30 - 2371.31 - Black shale containing a vertical fracture.
- 2371.31 - 2371.75 - Calcareous fossiliferous conglomerate containing a vertical fracture.
- 2371.75 - 2372.00 - Black shale containing a vertical fracture.
- 2372.00 - 2372.95 - Gray shale containing a vertical fracture.
- 2372.95 - 2375.00 - Soft gray shale.
- 2375.00 - 2376.00 - Loss, according to log, shale.

Coring was started at a depth of 2342.00 feet in fine grained micaceous sandstone and completed at 2376.00 feet in shale. There were two losses in the core, one extending from 2362.00 to 2366.00 feet and the other from 2375.00 to 2376.00 feet. According to the strip log, that part extending from 2362.00 to 2365.00 feet was sand. This core shows two vertical fractures, one extending from 2349.90 to 2350.40 feet and the other from 2366.00 to 2372.95 feet.

This core shows a total of 20.00 feet of sandstone. For the most part, the sand body is made up of fine grained micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are 1.98 and 7.11 millidarcys; the overall average being 4.25 (See Table II). By

observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile and is very tight.

PERCENT SATURATION & OIL CONTENT

The sand in this core has a low weighted average percent oil saturation, namely, 26.94. The weighted average percent oil saturation of the upper and lower sections are 28.17 and 25.67 respectively. The weighted average percent water saturation of the upper and lower sections are 51.53 and 48.61 respectively; the overall average being 50.15 (See Table IV). This gives an overall weighted average total fluid saturation of 77.09 percent. This comparatively low total fluid saturation indicates that an appreciable amount of fluid was lost during coring which was probably oil.

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 calculation of percent connate water. 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 some flushing of the sand did occur during coring, however, we are inclined to believe that most of the loss was due to the expansion of gas carried in solution by the oil.

The weighted average oil content of the upper and lower sections are 318 and 285 barrels per acre foot respectively; the overall average being 302. The total oil content, as shown by this core, is 5,366 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

The sand in this core responded very poorly to laboratory flooding

tests, as a total recovery of only 44 barrels of oil per acre was obtained from 1.4 feet of sand. The weighted average percent oil saturation was reduced from 26.93 to 24.29 or represents an average recovery of 2.64 percent. The weighted average effective permeability of the samples is 0.508 millidarcys, while the average initial fluid production pressure is 25.0 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 20 samples tested, 5 produced water and 2 oil. This indicates that only a small portion of the sand represented by these samples is floodable. The tests also show that much of the sand is impermeable to water at a pressure of 50 pounds per square inch over a pressure gradient of approximately two inches.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 900 barrels of oil per acre, or an average of 191 barrels per acre foot from the 4.7 feet of good floodable sand analyzed. 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 38 percent.

The principle drawback of this core is the fact that it is very tight and only a small portion of the sand would take water. Inasmuch as this core shows a long vertical fracture in the bottom of same, it is recommended that the hole be plugged back to a depth of 2365.00 feet with cement. Chances are if the other fracture should extend into some thief formation, it may be necessary to use selective plugging in the later stages of the flood.

Oil Field Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company The Ohio Oil Company Lease Martindell Well No. 43

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	2342.07	1.6	0.25	0.25	0.40
2	2342.33	1.3	0.25	0.50	0.32
3	2342.69	1.8	0.35	0.85	0.63
4	2343.08	2.9	0.40	1.25	1.16
5	2343.45	0.41	0.35	1.60	0.14
6	2343.88	2.8	0.50	2.10	1.40
7	2344.37	1.8	0.45	2.55	0.81
8	2344.78	4.4	0.35	2.90	1.54
9	2345.07	8.7	0.30	3.20	2.61
10	2345.38	0.47	0.55	3.75	0.26
11	2345.80	4.0	0.20	3.95	0.80
12	2346.15	3.1	0.35	4.30	1.09
13	2346.50	3.5	0.30	4.60	1.05
14	2346.85	0.46	0.25	4.85	0.12
15	2347.22	0.61	0.35	5.20	0.21
16	2347.68	2.1	0.40	5.60	0.84
17	2348.06	1.4	0.50	6.10	0.70
18	2348.64	1.5	0.50	6.60	0.75
19	2348.97	1.5	0.35	6.95	0.53
20	2349.38	1.3	0.55	7.50	0.72
21	2349.97	0.71	0.18	7.68	0.13
22	2350.47	2.2	0.48	8.16	1.06
23	2351.07	0.95	0.50	8.66	0.48
24	2351.57	1.2	0.50	9.16	0.60
25	2352.03	2.9	0.50	9.66	1.45
26	2352.57	0.85	0.45	10.11	0.38
27	2352.94	1.2	0.30	10.41	0.36
28	2353.20	0.37	0.35	10.76	0.13
29	2353.63	8.7	0.50	11.26	4.35
30	2354.25	4.8	0.60	11.86	2.88
31	2354.83	1.3	0.65	12.51	0.85
32	2355.54	2.9	0.75	13.26	2.18
33	2356.00	Imp.	0.25	13.51	0.00
34	2356.33	1.9	0.45	13.96	0.85
35	2356.77	1.6	0.63	14.59	1.01
36	2357.33	1.6	0.25	14.84	0.40
37	2357.67	3.1	0.40	15.24	1.24
38	2358.19	8.0	0.50	15.74	4.00
39	2358.75	16.	0.55	16.29	8.80
40	2359.18	11.	0.45	16.74	4.95

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company The Ohio Oil Company Lease Martindell Well No. 43

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	2359.64	15.	0.45	17.19	6.75
42	2360.08	15.	0.35	17.54	5.25
54	2360.35	15.	0.60	18.14	9.00
44	2360.93	0.52	0.20	18.34	0.10
45	2361.46	4.2	0.27	18.61	1.13
46	2361.93	16.	0.30	18.91	4.80

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company	The Ohio Oil Company	Lease	Martindell	Well No.	43
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.		
2342.00 - 2353.05	10.41	1.98	20.54		
2353.05 - 2362.00	8.25	7.11	58.67		
2342.00 - 2362.00	18.66	4.25	79.29		

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RESULTS OF SATURATION TESTS

TABLE III

Company The Ohio Oil Company Lease Martindell Well No. 43

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	2342.46	15.3	26.2	49.2	75.4	311	0.85	0.85	264
2	2343.23	15.3	24.8	51.5	76.3	295	0.75	1.60	222
3	2344.53	15.2	34.3	56.0	90.3	405	1.40	3.00	566
4	2345.55	15.2	28.2	55.5	83.7	333	0.75	3.75	250
5	2446.63	14.5	16.2	68.8	85.0	182	1.05	4.80	191
6	2447.85	15.2	35.3	42.7	78.0	415	0.35	5.15	145
7	2448.40	15.4	33.0	47.2	80.2	395	0.85	6.00	336
8	2449.55	13.8	32.5	47.7	80.2	348	0.70	6.70	244
9	2350.60	13.0	27.4	41.4	68.8	276	0.83	7.53	229
10	2351.70	13.6	31.1	43.3	74.4	328	1.05	8.58	344
11	2352.73	14.0	22.4	52.7	75.1	243	0.85	9.43	206
12	2353.36	15.4	27.4	46.5	73.9	327	0.85	10.28	278
13	2354.48	14.9	23.5	49.9	73.4	272	0.95	11.23	258
14	2355.23	13.6	22.0	53.3	75.3	232	1.05	12.28	244
15	2356.50	10.4	25.7	50.0	75.7	207	1.33	13.61	276
16	2357.85	14.7	27.4	44.4	71.8	312	0.97	14.58	302
17	2358.45	16.2	25.8	48.5	74.3	324	0.65	15.23	210
18	2359.33	15.7	23.9	47.3	71.2	291	1.05	16.28	306
19	2360.53	14.7	30.3	45.7	76.0	346	0.90	17.18	312
20	2361.64	15.9	26.1	51.7	77.8	322	0.57	17.75	183
Total							Total		5,366

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SUMMARY OF SATURATION TESTS

TABLE IV

Company	The Ohio Oil Company	Lease	Martindell	Well No.	43	
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
2342.00-2353.05	9.43	14.58	28.17	51.53	318	2,997
2353.05-2362.00	8.32	14.30	25.67	48.61	285	2,369
2342.00-2362.00	17.75	14.46	26.94	50.15	302	5,366

Oil Field Research
RESULTS OF LABORATORY TESTS

TABLE

Company The Ohio Oil Company Lease Mar

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery	
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.
1	2342.56	14.7	26.9	307	0.0	0
2	2343.33	15.5	25.1	302	0.0	0
3	2344.62	14.8	33.9	390	0.0	0
4	2345.66	15.1	28.2	331	3.8	45
5	2346.74	14.5	18.5	208	0.0	0
6	2347.94	15.6	34.1	413	0.0	0
7	2348.50	15.6	31.1	377	0.0	0
8	2349.65	13.8	33.0	354	0.0	0
9	2350.70	13.6	26.9	284	0.0	0
10	2351.80	13.8	30.5	327	0.0	0
11	2352.83	13.7	21.9	233	0.0	0
12	2353.44	15.3	26.8	318	0.0	0
13	2354.62	14.9	23.6	273	0.0	0
14	2355.37	13.7	23.2	247	0.0	0
15	2356.64	10.0	25.7	200	0.0	0
16	2357.97	14.7	26.2	299	0.0	0
17	2358.50	15.9	25.4	313	1.2	15
18	2359.47	15.6	24.5	297	0.0	0
19	2360.65	14.6	31.3	355	0.0	0
20	2361.76	15.6	27.0	327	0.0	0

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

Field Research Laboratories

LABORATORY FLOODING TESTS

TABLE V

Martindell

Well No. 43

Core Sample No. Bbls./A. Ft.	Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
	% Oil	% Water	Bbls./A. Ft.			
0	26.9	61.2	307	0	Imp.	50 +
0	25.1	56.0	302	0	Imp.	50 +
0	33.9	55.9	390	0	Imp.	50 +
45	24.4	68.6	286	-	Cracked	---
0	18.5	65.3	208	0	Imp.	50 +
0	34.1	49.1	413	0	Imp.	50 +
0	31.1	52.2	377	0	Imp.	50 +
0	33.0	50.8	354	0	Imp.	50 +
0	26.9	54.1	284	7	0.145	40
0	30.5	54.5	327	0	Imp.	50 +
0	21.9	64.0	233	0	Imp.	50 +
0	26.8	58.0	318	5	0.100	40
0	23.6	54.5	273	0	Imp.	50 +
0	23.2	55.9	247	0	Imp.	50 +
0	25.7	67.3	200	0	Imp.	50 +
0	26.2	64.7	299	0	Imp.	50 +
15	24.2	64.5	298	19	0.508	25
0	24.5	65.0	297	6	0.145	40
0	31.3	61.9	355	0	Imp.	50 +
0	27.0	64.5	327	29	0.787	20

0.5 of maximum oil recovery.
sample which still contains residual oil.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company	The Ohio Oil Company	Lease	Martindell	Well No.	43
Depth Interval, Feet	2345.00 - 2358.85				
Feet of Core Analyzed	1.40				
Average Percent Porosity	15.43				
Average Percent Original Oil Saturation	26.93				
Average Percent Oil Recovery	2.64				
Average Percent Residual Oil Saturation	24.29				
Average Percent Residual Water Saturation	66.79				
Average Percent Total Residual Fluid Saturation	91.08				
Average Original Oil Content, Bbls./A. Ft.	322.				
Average Oil Recovery, Bbls./A. Ft.	31.				
Average Residual Oil Content, Bbls./A. Ft.	291.				
Total Original Oil Content, Bbls./Acre	452.				
Total Oil Recovery, Bbls./Acre	44.				
Total Residual Oil Content, Bbls./Acre	408.				
Average Effective Permeability, Millidarcys	0.508				
Average Initial Fluid Production Pressure, p.s.i.	25.0				

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 Martindell Well No. 43

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2342.46	62,700	49.0	0.2	49.2
2	2343.23	58,100	47.5	4.0	51.5
3	2344.53	56,000	49.8	6.2	56.0
4	2345.55	55,000	48.5	7.0	55.5
5	2346.63	57,700	63.1	5.7	68.8
6	2347.85	72,500	42.7	0.0	42.7
7	2348.40	59,400	44.6	2.6	47.2
8	2349.55	64,500	47.7	0.0	47.7
9	2350.60	61,000	40.2	1.2	41.4
10	2351.70	72,800	43.3	0.0	43.3
11	2352.73	51,200	42.9	9.8	52.7
12	2353.36	68,000	46.5	0.0	46.5
13	2354.48	49,600	39.4	10.5	49.9
14	2355.23	51,500	43.6	9.7	53.3
15	2356.00	58,000	46.1	3.9	50.0
16	2357.85	58,800	41.5	2.9	44.4
17	2358.45	53,700	41.5	7.0	48.5
18	2359.33	55,300	42.5	4.8	47.3
19	2360.53	54,700	39.8	5.9	45.7
20	2361.64	48,000	39.5	12.2	51.7

Note: ppm - parts per million.

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company	The Ohio Oil Company	Lease	Martindell	Well No.	43
Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water		
2342.00 - 2353.05	60,350	47.86	3.68		
2353.05 - 2362.00	55,607	42.60	6.03		
2342.00 - 2362.00	58,132	45.39	4.78		

Note: ppm - parts per million.