OILFIELD RESEARCH LABORATORIES

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December 27, 1962

Layton Oil Company
P.O. Box 263
Independence, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Hough Lease, Well No. K-14, Woodson County, Kansas, and submitted to our laboratory on December 21, 1962.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

Benjamin R. Pearman

BRP:rf

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GENERAL INFORMATION & SUMMARY

Company Layton Oil Co. Lease Hough Well No. K-14

Location

Section Twp. Rge. County Woodson State Kansas

Name of Sand	Squirrel
Top of Core	851.0
Bottom of Core	878.5
Top of Sand (Analyzed)	853.0
Bottom of Sand	876.0
Total Feet of Permeable Sand	17.3
Total Feet of Floodable Sand	9.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 1	2.4	2.4
1 - 10	2.0	4.4
10 - 50	6.7	11.1
50 - 100	4.2	15.3
100 & above	2.0	17.3

Average Permeability Millidarcys	43.8
Average Percent Porosity (Pay Sand)	18.8
Average Percent Oil Saturation (Pay Sand)	57.3
Average Percent Water Saturation (Pay Sand)	15.0
Average Oil Content, Bbls./A. Ft. (Pay Sand)	835.
Total Oil Content, Bbls./Acre (Pay Sand)	7,510.
Average Percent Oil Recovery by Laboratory Flooding Tests	10.4
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	152.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,364.
Total Calculated Oil Recovery, Bbls./Acre	2,160.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	1,034.3

Fresh water was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories. The well was drilled in non-virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
851.0 - 853.0	Sandy shale.
853.0 - 860.0	Dark brown, laminated, slightly shaly sandstone.
860.0 - 866.3	Brown to dark, laminated, slightly shaly sandstone.
866.3 - 868.0	Sandy shale.
868.0 - 876.0	Dark carbonaceous shaly sandstone.
876.0 - 878.5	Sandy shale.

Coring was started at a depth of 851.0 feet in sandy shale and completed at 878.5 feet also in sandy shale. This core shows a total of 19.3 feet of sandstone. For the most part, the pay is made up of dark brown, laminated, slightly shaly sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 63.9, 37.7 and 2.9 millidarcys respectively; the overall average being 43.8 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 114. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 51.4. The weighted average percent oil saturation of

the upper, middle and lower sections is 56.8, 52.4 and 42.1 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 14.7, 20.2 and 40.2 respectively; while that of the pay sand is 15.0, the overall average being 23.3 (See Table III). This gives an overall weighted average total fluid saturation of 74.7 percent. This low total fluid saturation indicates considerable fluid was lost during coring most of which probably was oil.

The weighted average oil content of the upper, middle and lower sections is 824, 746 and 494 barrels per acre foot respectively; while that of the pay sand is 835, the overall average being 709. The total oil content, as shown by this core, is 13,696 barrels per acre of which 7,510 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The upper portion of the sand in this core responded to laboratory flooding tests, as a total recovery of 1,364 barrels of oil per acre was obtained from 9.0 feet of sand. The weighted average percent oil saturation was reduced from 57.3 to 46.9, or represents an average recovery of 10.4 percent. The weighted average effective permeability of the samples is 0.96 millidarcys, while the average initial fluid production pressure is 30.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 20 samples tested, 10 produced water and 9 oil. This indicates that approximately 45 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a wide variation in effective permeability to water.

CONCLUSION

The results of the laboratory tests indicate that efficient waterflood operations in the vicinity of this well should recover approximat-

ely 2,160 barrels of oil per acre or an average of 240 barrels per acre foot from the 9.0 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.06
Present formation volume factor	1.02
Reservoir water saturation, percent	12.0
Primary recovery, estimated, percent	6.0
Present oil saturation, percent	78.7
Average porosity, percent	18.8
Oil saturation after flooding, percent	46.9
Performance factor, percent	55.0
Net floodable pay sand, feet	9.0

This core shows a pay sand section having a good oil saturation, a low water saturation and a wide variation in effective permeability to water.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Layton Oil Co. Lease Hough Well No. K-14

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. / A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
1	853.1	16.4	52	11	63	660	94.	0.6	0.6	396	56.40
2	854.1	19.0	72	9	81	1061	114.	1.0	1.6	1,061	114.00
3	855.1	17.0	58	13	71	765	36.	1.0	2.6	765	36.00
4	856.1	19.5	58	16	74	876	69.	1.0	3.6	876	69.00
5	857.1	18.7	68	15	83	985	54.	1.0	4.6	985	54.00
6	858.1	20.0	56	14	70	869	108.	1.0	5.6	869	108.00
7	859.1	16.8	41	22	63	534	50.	1.4	7.0	747	70.00
8	860.1	20.7	51	17	68	819	43.	0.6	7.6	491	25.80
9	861.1	20.0	57	12	69	884	16.	1.0	8.6	884	16.00
10	862.1	18.3	31	28	59	439	47.	1.0	9.6	439	47.00
11	863.1	15.9	47	33	80	579	0.31	1.0	10.6	579	0.31
12	864.1	17.4	58	15	73	781	34.	1.0	11.6	781	34.00
13	865.1	18.4	60	15	75	856	64.	1.0	12.6	856	64.00
14	866.1	21.8	68	9	77	1149	34.	0.7	13.3	805	23.80
15	868.1	18.8	57	16	73	830	51.	0.6	13.9	498	30.60
16	869.1	17.0	59	20	79	778	2.7	1.0	14.9	778	2.70
17	870.1	15.7	60	20	80	730	6.1	1.0	15.9	730	6.10
18	873.1	13.9	32	54	86	345	Imp.	1.0	16.9	345	0.00
19	874.1	12.0	29	68	97	270	Imp.	1.0	17.9	270	0.00
20	875.1	14.7	34	39	73	387	0.64	1.4	19.3	541	0.90
								Total	-------	-13,696	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Layton Oil Co. Lease Hough Well No. K-14

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
853.0 - 861.6	8.6	63.9	549.20
861.6 - 868.6	5.3	37.7	199.71
868.6 - 876.0	3.4	2.9	9.70
853.0 - 876.0	17.3	43.8	758.61

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
853.0 - 861.6	8.6	18.7	56.8	14.7	824	7,074
861.6 - 868.6	5.3	18.3	52.4	20.2	746	3,958
868.6 - 876.0	5.4	14.7	42.1	40.2	494	2,664
853.0 - 876.0	19.3	17.4	51.4	23.3	709	13,696

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Layton Oil Co. Lease Hough Well No. K-14

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	853.1	16.0	50	620	0	0	50	45	620	0	Imp.	-
2	854.1	19.4	72	1083	24	361	48	50	722	26	0.500	30
3	855.1	17.5	58	786	8	109	50	46	677	78	1.50	20
4	856.1	19.2	58	864	8	119	50	44	745	60	1.20	20
5	857.1	18.5	68	975	25	358	43	48	617	32	0.600	30
6	858.1	19.8	56	860	4	61	52	44	799	18	0.600	40
7	859.1	17.1	41	543	4	53	37	57	490	76	1.30	20
8	860.1	21.0	51	829	5	81	46	47	748	114	2.50	30
9	861.1	20.2	57	893	7	110	50	27	783	27	0.600	30
10	862.1	18.0	33	460	0	0	33	52	460	22	0.400	30
11	863.1	15.4	48	573	0	0	48	35	573	0	Imp.	-
12	864.1	17.6	58	791	9	123	49	37	668	9	0.300	50
13	865.1	18.7	60	870	0	0	60	15	870	0	Imp.	-
14	866.1	21.5	65	1083	0	0	65	14	1083	0	Imp.	-
15	868.1	18.7	54	784	0	0	54	19	784	0	Imp.	-
16	869.1	16.8	57	741	0	0	57	23	741	0	Imp.	-
17	870.1	15.3	60	711	0	0	60	20	711	0	Imp.	-
18	873.1	14.4	37	413	0	0	37	51	413	0	Imp.	-
19	874.1	12.4	32	308	0	0	32	67	308	0	Imp.	-
20	875.1	15.0	30	348	0	0	30	42	348	0	Imp.	-

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.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Layton Oil Co. Lease Hough Well No. K-14

Depth Interval, Feet	853.0 - 861.6	861.6 - 864.6	853.0 - 864.6
Feet of Core Analyzed	8.0	1.0	9.0
Average Percent Porosity	18.9	17.6	18.8
Average Percent Original Oil Saturation	57.2	58.0	57.3
Average Percent Oil Recovery	10.6	9.0	10.4
Average Percent Residual Oil Saturation	46.6	49.0	46.9
Average Percent Residual Water Saturation	45.9	37.0	44.9
Average Percent Total Residual Fluid Saturation	92.5	86.0	91.8
Average Original Oil Content, Bbls./A. Ft.	840.	791.	835.
Average Oil Recovery, Bbls./A. Ft.	155.	123.	152.
Average Residual Oil Content, Bbls./A. Ft.	685.	668.	683.
Total Original Oil Content, Bbls./Acre	6,719.	791.	7,510.
Total Oil Recovery, Bbls./Acre	1,241.	123.	1,364.
Total Residual Oil Content, Bbls./Acre	5,478.	668.	6,146.
Average Effective Permeability, Millidarcys	1.04	0.30	0.96
Average Initial Fluid Production Pressure, p.s.i.	27.5	50.0	30.0

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