● CORE ANALYSIS ● WATER REPRESSURING ENGINEERING ● WATER ANALYSIS ● FLOODING WATER TREATMENT ● SURVEYING

OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

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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. L-11-30, Woodson County, Kansas, and submitted to our laboratory on December 18, 1962.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

Benjamin R. Pearman

BRP:rf

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T26S, R17E, Sec. 30

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GENERAL INFORMATION & SUMMARY

Company Layton Oil Co. Lease Hough Well No. L-11-30

Location

Section Twp. Rge. County Woodson State Kansas

Name of Sand	Squirrel
Top of Core	838.3
Bottom of Core	866.0
Top of Sand	840.0
Bottom of Sand	861.3
Total Feet of Permeable Sand	20.0
Total Feet of Floodable Sand	8.1

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 1	2.0	2.0
1 - 5	2.6	4.6
5 - 10	1.3	5.9
10 - 50	8.3	14.2
50 - 100	4.8	19.0
100 & above	1.0	20.0

Average Permeability Millidarcys	36.6
Average Percent Porosity (Pay Sand)	19.2
Average Percent Oil Saturation (Pay Sand)	52.3
Average Percent Water Saturation (Pay Sand)	17.7
Average Oil Content, Bbls./A. Ft. (Pay Sand)	778.
Total Oil Content, Bbls./Acre (Pay Sand)	6,299.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.4
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	93.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	756.
Total Calculated Oil Recovery, Bbls./Acre	2,120.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

The core was sampled and the samples sealed in cans by a representative of Oilfiled 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
838.3 - 840.0	Laminated sandstone and shale.
840.0 - 846.3	Dark brown, slightly shaly sandstone.
846.3 - 858.5	Dark carbonaceous sandstone.
858.5 - 859.8	Gray sandy shale.
859.8 - 861.3	Brown sandstone.
861.3 - 866.0	Shale.

Coring was started at a depth of 838.3 feet in laminated sandstone and shale and completed at 866.0 feet in shale. This core shows a total of 20.0 feet of sandstone. For the most part, the pay is made up of dark brown, slightly shaly sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeabilty of the upper, middle and lower sections is 41.8, 46.4 and 15.6 millidarcys respectively; the overall average being 36.6 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather regular permeability profile in the pay section. The permeability of the sand varies from 0.31 to a maximum of 103. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 52.3. The weighted average percent oil saturation of the upper, middle and lower sections is 50.5, 59.5 and 43.5 respectively. The weighted average percent water saturation of the upper, middle

and lower sections is 19.1, 11.1 and 30.6 respectively; the overall average being 18.8 (See Table III). This gives an overall weighted average total fluid saturation of 71.1 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 740, 925 and 546 barrels per acre foot respectively; the overall average being 764. The total oil content, as shown by this core, is 15,292 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 756 barrels of oil per acre was obtained from 8.1 feet of sand. The weighted average percent oil saturation was reduced from 52.3 to 45.9, or represents an average recovery of 6.4 percent. The weighted average effective permeability of the samples is 1.67 millidarcys, while the average initial fluid production pressure is 31.1 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 21 samples tested, 10 produced water and 9 oil. This indicates that approximately 43 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a rather wide variation in effective permeability to water.

CONCLUSION

The results of the laboratory tests indicate that an efficient water-flood in the vicinity of this well whould recover approximately 2,120 barrels of oil per acre or an average of 262 barrels per acre foot from the 8.1 feet of floodable 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	78.6
Average porosity, percent	19.2
Oil saturation after flooding, percent	45.9
Performance factor, percent	55.0
Net floodable pay sand, feet	8.1

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.** L-11-30

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	840.1	17.5	52	21	73	706	20.	0.6	0.6	424	12.00
2	841.1	17.9	57	18	75	790	24.	1.0	1.6	790	24.00
3	842.1	18.7	56	14	70	811	36.	1.0	2.6	811	36.00
4	843.1	19.4	58	12	70	872	59.	1.0	3.6	872	59.00
5	844.1	20.2	45	24	69	703	58.	1.0	4.6	703	58.00
6	845.1	19.5	40	24	64	605	42.	1.0	5.6	605	42.00
7	846.1	19.3	44	22	66	657	46.	0.7	6.3	460	32.20
8	847.1	18.6	62	14	76	893	7.1	1.3	7.6	1,161	9.23
9	848.1	20.4	50	12	62	791	31.	1.0	8.6	791	31.00
10	849.1	21.2	63	12	75	1,036	103.	1.0	9.6	1,036	103.00
11	850.1	19.3	57	13	70	852	85.	1.0	10.6	852	85.00
12	851.1	21.0	67	11	78	1,090	97.	1.0	11.6	1,090	97.00
13	852.1	20.5	58	9	67	925	32.	1.0	12.6	925	32.00
14	853.1	20.3	65	6	71	1,025	16.	1.0	13.6	1,025	16.00
15	854.1	19.0	54	11	65	796	11.	1.0	14.6	796	11.00
16	855.1	18.1	62	9	71	872	0.31	1.0	15.6	872	0.31
17	856.1	10.6	30	66	96	247	0.79	1.0	16.6	247	0.79
18	857.1	15.6	24	31	55	290	1.9	1.0	17.6	290	1.90
19	858.1	15.6	53	28	81	643	1.1	0.9	18.5	578	0.99
20	860.1	18.7	48	16	64	696	99.	0.8	19.3	556	79.20
21	861.1	16.3	46	30	76	582	1.6	0.7	20.0	408	1.12
								Total	-------	15,292	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Layton Oil Co. Lease Hough Well No. L-11-30

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
840.0 - 846.3	6.3	41.8	263.20
846.3 - 854.6	8.3	46.4	384.23
854.6 - 861.3	5.4	15.6	84.31
840.0 - 861.3	20.0	36.6	731.74

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
840.0 - 846.3	6.3	19.0	50.5	19.1	740	4,665
846.3 - 854.6	8.3	20.0	59.5	11.1	925	7,676
854.6 - 861.3	5.4	15.7	43.5	30.6	546	2,951
840.0 - 861.3	20.0	18.5	52.3	18.8	764	15,292

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Layton Oil Co. Lease Hough Well No. L-11-30

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	Effective Permeability Millidarcys**	Initial Field Production Pressure Lbs./Sq./In.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	840.1	17.9	52	721	5	69	47	40	652	45	1.00	30
2	841.1	17.6	57	778	8	109	49	49	669	25	0.700	30
3	842.1	18.5	56	803	13	186	43	50	617	4	0.200	50
4	843.1	19.3	58	868	6	90	52	47	778	60	1.50	20
5	844.1	20.2	45	704	2	31	43	52	673	40	1.10	40
6	845.1	19.3	40	599	3	45	37	57	554	137	3.70	20
7	846.1	19.6	44	669	4	61	40	41	608	55	1.40	20
8	847.1	18.5	60	861	0	0	60	19	861	0	Imp.	-
9	848.1	20.0	51	790	0	0	51	14	790	0	Imp.	-
10	849.1	21.4	62	1029	0	0	62	11	1029	0	Imp.	-
11	850.1	19.3	54	808	0	0	54	51	808	6	0.600	50
12	851.1	20.8	67	1080	5	81	62	29	999	2	0.140	50
13	852.1	20.8	60	966	0	0	60	7	966	0	Imp.	-
14	853.1	20.0	65	1009	0	0	65	8	1009	0	Imp.	-
15	854.1	19.1	52	770	0	0	52	10	770	0	Imp.	-
16	855.1	18.5	59	846	0	0	59	12	846	0	Imp.	-
17	856.1	10.2	32	253	0	0	32	67	253	0	Imp.	-
18	857.1	15.8	28	343	0	0	28	30	343	0	Imp.	-
19	858.1	15.7	50	609	0	0	50	33	609	0	Imp.	-
20	860.1	19.0	48	706	11	162	37	55	544	274	5.74	20
21	861.1	16.5	48	614	0	0	48	40	614	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. L-11-30

Depth Interval, Feet	840.0 - 846.3	846.3 - 861.3	840.0 - 861.3
Feet of Core Analyzed	6.3	1.8	8.1
Average Percent Porosity	19.0	20.0	19.2
Average Percent Original Oil Saturation	50.5	58.7	52.3
Average Percent Oil Recovery	6.0	7.7	6.4
Average Percent Residual Oil Saturation	44.5	51.0	45.9
Average Percent Residual Water Saturation	48.8	40.6	47.0
Average Percent Total Residual Fluid Saturation	93.3	91.6	92.9
Average Original Oil Content, Bbls./A. Ft.	739.	913.	778.
Average Oil Recovery, Bbls./A. Ft.	87.	117.	93.
Average Residual Oil Content, Bbls./A. Ft.	652.	796.	685.
Total Original Oil Content, Bbls./Acre	4,654.	1,645.	6,299.
Total Oil Recovery, Bbls./Acre	545.	211.	756.
Total Residual Oil Content, Bbls./Acre	4,109.	1,434.	5,543.
Average Effective Permeability, Millidarcys	1.39	2.62	1.67
Average Initial Fluid Production Pressure, p.s.i.	30.0	35.0	31.1

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