● CORE ANALYSIS ● WATER REPRESSURING ENGINEERING ● WATER ANALYSIS ● FLOODING WATER TREATMENT ● SURVEYING
JOHN R. LAVENS, JR. - REGISTERED ENGINEERS - CARL L. PATE

OIL FIELD RESEARCH LABORATORIES
1028 S. SANTA FE TELEPHONE 728
CHANUTE, KANSAS

May 22, 1952

Walter Ives Oil Company
804 Ritz Building
Tulsa, Oklahoma

Gentlemen:

Enclosed herewith is the report of the analysis of the Keystone barrel core taken from the Earl McGrew Lease, Well No. 1, Linn County, Kansas, and submitted to our laboratory on July 6, 1949.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:bl
c.c.

WALTER IVES OIL COMPANY

CORE ANALYSIS REPORT

EARL McGREW LEASE WELL NO. 1

LINN COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

MAY 22, 1952

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Location

Section 20 Twp. 21 Rge. 23 County Linn State Kansas

Name of Sand	Squirrel
Top of Core	492.00
Bottom of Core	513.35
Top of Pay Sand	?
Bottom of Sand	512.55
Total Feet of Permeable Sand	19.25
Total Feet of Floodable Sand	

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	1.35	1.35
5 - 10	2.90	4.25
10 - 20	4.30	8.55
20 - 40	6.70	15.25
40 - 60	2.80	18.05
60 & above	1.20	19.25

Average Permeability Millidarcys	26.52
Average Percent Porosity	20.87
Average Percent Oil Saturation	51.22
Average Percent Water Saturation	33.79
Average Oil Content, Bbls./A. Ft.	832.
Total Oil Content, Bbls./Acre	16,746.
Average Percent Oil Recovery by Laboratory Flooding Tests	19.96
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	344.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,567.
Total Calculated Oil Recovery, Bbls./Acre	1,650.
Packer Setting, Feet	493.0
Viscosity, Centipoises @ 73°F.	17.2
A. P. I. Gravity, degrees @ 60 °F	31.7
Elevation, Feet	

In order to get a true water saturation of the sand, crude oil 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:

Depth Interval, Feet	Description
492.00 - 492.40	Cavings.
492.40 - 496.15	Dark brown fine grained micaceous sandstone.
496.15 - 499.30	Dark fine grained micaceous carbonaceous sandstone.
499.30 - 512.55	Dark fine grained micaceous carbonaceous slightly shaley sandstone.
512.55 - 513.35	Black shale.

Coring was started at a depth of 492.00 feet in fine grained micaceous sandstone, and completed at 513.35 feet in dark shale. According to the driller, the top of the gas sand was found at a depth of 472.00 feet. This core shows a total of 20.15 feet of sandstone. For the most part, the sand body is made up of fine grained micaceous to carbonaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 49.21 and 17.90 millidarcys respectively; the overall average being 26.52 (See Table II). By observing the data given in Table II and on the coregraph, it is noticeable that the upper part of the cored section has a considerable higher permeability. By comparing the average permeability of the sand in this core with that taken from the Houghton Well No. 4, it is noticeable that it is considerable lower.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 51.22. The weighted average percent oil saturation of the upper and lower sections are 46.34 and 53.19 respectively. The weighted average percent water saturation of the upper and lower sections is 33.28 and 33.99 respectively; the overall average being 33.79 (See Table IV). This gives an overall weighted average total fluid saturation of 84.91 percent.

For future reference, chloride determinations were made on all the saturation samples. The results of these tests are given in Tables VII and VIII.

The weighted average oil content of the upper and lower sections is 797 and 845 barrels per acre foot respectively; the overall average being 832. The total oil content, as shown by this core, is 16,746 barrels per acre (See Table IV).

VISCOSITY

The viscosity of a sample of crude oil bailed from the core hole is 17.2 centipoises at 73° F. The A.P.I. gravity of the oil is 31.7° at 60° F. By comparing the viscosity of this oil with that taken from the Dunavan Well No. 3, it is noticeable that it is considerable lower. With other factors being favorable, a sand containing an oil with a viscosity of 17.2 centipoises should respond very satisfactorily to water repressuring.

LABORATORY FLOODING TESTS

The upper 4.55 feet of sand responded very well to laboratory flooding tests as a total recovery of 1,567 barrels per acre was

obtained from this zone. The weighted average percent oil saturation was reduced from 45.17 to 25.21, or represents an average recovery of 19.96 percent. The weighted average effective permeability of the samples is 3.60 millidarcys, while the average initial fluid production pressure is 22.0 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the eleven samples tested, only five produced oil and took water. This would indicate that the lower part of the sand section is not floodable.

CONCLUSION

From a study of the above data, we believe an efficient water flood within the vicinity of this well will recover approximately 1,650 barrels of oil per acre, provided the property is developed for water repressuring in the very near future. On the basis of this core, it is estimated that of the 1,650 barrels, 550 barrels of oil per acre can be recovered by primary production.

The principle drawback of this core is the fact that it contains only approximately 4.50 feet of floodable sand. The lower part of the sand section is very rich, however, it will not take water.

Oil Field Research Laboratories

SHOT RECOMMENDATION

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
497.0 - 499.0	2.0	4½	3.1	6.2

Recommended Packer Setting - 493.0 feet.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	492.54	39.	0.40	0.40	15.60
2	492.95	48.	0.40	0.80	19.20
3	493.50	53.	0.50	1.30	26.50
4	493.94	85.	0.45	1.75	38.25
5	494.40	72.	0.45	2.20	32.40
6	494.80	66.	0.30	2.50	19.80
7	495.10	57.	0.35	2.85	19.95
8	495.45	48.	0.35	3.20	16.80
9	495.75	Broken	0.30	3.50	-
10	496.06	44.	0.25	3.75	11.00
11	496.34	40.	0.30	4.05	12.00
12	496.50	39.	0.25	4.30	9.75
13	496.77	53.	0.20	4.50	10.60
14	497.00	30.	0.25	4.75	7.50
15	497.35	21.	0.45	5.20	9.45
16	497.85	30.	0.40	5.60	12.00
17	498.25	54.	0.45	6.05	24.30
18	498.70	21.	0.45	6.50	9.45
19	499.24	23.	0.40	6.90	9.20
20	499.57	2.5	0.35	7.25	0.88
21	499.75	0.82	0.35	7.60	0.29
22	500.26	9.5	0.50	8.10	4.75
23	500.70	15.	0.40	8.50	6.00
24	501.05	11.	0.40	8.90	4.40
25	501.45	5.3	0.30	9.20	1.59
26	501.76	4.0	0.40	9.60	1.60
27	502.13	28.	0.20	9.80	5.60
28	502.35	11.	0.40	10.20	4.40
29	502.84	6.2	0.40	10.60	2.48
30	503.23	13.	0.30	10.90	3.90
31	503.40	9.2	0.25	11.15	2.30
32	503.64	2.6	0.25	11.40	0.65
33	503.94	26.	0.35	11.75	9.10
34	504.35	18.	0.35	12.10	6.30
35	504.85	30.	0.50	12.60	15.00
36	505.40	14.	0.80	13.40	11.20
37	506.30	30.	0.60	14.00	18.00
38	506.60	15.	0.50	14.50	7.50
39	507.26	38.	0.60	15.10	22.80
40	507.85	29.	0.50	15.60	14.50

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	508.30	18.	0.45	16.05	8.10
42	508.61	31.	0.75	16.80	23.25
43	509.63	13.	0.70	17.50	9.10
44	510.26	21.	0.60	18.10	12.60
45	510.74	Broken	0.60	18.70	-
46	511.45	5.7	0.55	19.25	3.14
47	511.90	8.1	0.90	20.15	7.29

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
492.40 - 498.20	5.30	49.21	260.80
498.20 - 512.55	13.95	17.90	249.67
492.40 - 512.55	19.25	26.52	510.47

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

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	492.83	21.9	44.7	37.4	82.1	758	1.00	1.00	758
2	494.23	23.0	57.3	29.4	86.7	1,022	1.50	2.50	1,535
3	495.62	21.9	48.4	30.8	79.2	821	1.25	3.75	1,028
4	496.63	21.2	36.0	33.8	69.8	594	1.00	4.75	594
5	497.62	22.0	39.6	37.3	76.9	676	1.05	5.80	710
6	498.91	21.6	59.0	32.2	91.2	990	1.10	6.90	1,090
7	500.15	19.3	42.2	43.3	85.5	631	1.30	8.20	821
8	501.35	20.6	46.1	36.1	82.2	735	1.20	9.40	884
9	502.26	20.9	54.1	34.9	89.0	876	1.10	10.50	965
10	503.50	19.1	43.3	41.3	84.6	642	1.25	11.75	801
11	504.67	21.5	57.1	33.4	90.5	955	1.25	13.00	1,191
12	506.07	20.3	53.8	34.4	88.2	850	1.30	14.30	1,105
13	507.18	20.2	56.6	30.9	87.5	885	1.00	15.30	885
14	508.20	22.6	62.8	30.2	93.0	1,101	1.00	16.30	1,101
15	509.08	22.2	62.6	26.3	88.9	1,079	0.90	17.20	970
16	510.13	19.6	53.7	26.5	80.2	815	1.00	18.20	815
17	511.03	17.5	52.4	33.4	85.8	713	1.05	19.25	748
18	512.35	19.8	53.9	33.4	87.3	829	0.90	20.15	745
							Total	- - - - -	16,746

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

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
492.40 - 498.20	5.80	22.09	46.34	33.28	797	4,625
498.20 - 512.55	14.35	20.38	53.19	33.99	845	12,121
492.40 - 512.55	20.15	20.87	51.22	33.79	832	16,746

Oil I

RESULTS (

Company Ives Oil Company

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Reco
			Percent	Bbls./A. Ft.	Percent
1	492.67	22.0	46.1	788	24.8
2	494.08	22.6	57.8	1,014	33.7
3	496.22	21.6	35.9	602	4.4
4	496.85	22.1	26.8	460	2.3
5	497.45	21.4	39.6	658	11.5
6	499.10	20.5	57.4	913	0.0
7	499.95	18.7	40.2	585	0.0
8	501.18	19.8	45.8	705	0.0
11	509.25	19.4	63.6	956	0.0
12	510.85	15.9	51.8	640	0.0
13	512.45	17.6	57.2	780	0.0

Notes: cc - cubic ce
*Volume of wa
**Determined b

Field Research Laboratories

OF LABORATORY FLOODING TESTS

TABLE V

Lease Earl McGrew Well No. 1

very Bbls./A. Ft.	Residual Saturation % Oil	% Water	Bbls./A. Ft.	Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
424	21.3	76.0	364	63	4.14	15
591	24.1	74.7	423	173	6.06	5
74	31.5	61.5	528	4	0.374	30
40	24.5	66.5	420	45.5	1.35	30
191	28.1	70.3	467	32	2.12	30
0	57.4	34.2	913	0	Imp.	50#
0	40.2	55.4	585	0	Imp.	50#
0	45.8	44.8	705	0	Imp.	50#
0	63.6	29.2	956	0	Imp.	50#
0	51.8	42.7	640	0	Imp.	50#
0	57.2	36.0	780	0	Imp.	50#

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ter recovered at the time of maximum oil recovery.
y passing water through sample which still contains residual oil.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Depth Interval, Feet	492.40 - 498.20
Feet of Core Analyzed	4.55
Average Percent Porosity	22.02
Average Percent Original Oil Saturation	45.17
Average Percent Oil Recovery	19.96
Average Percent Residual Oil Saturation	25.21
Average Percent Residual Water Saturation	71.67
Average Percent Total Residual Fluid Saturation	96.88
Average Original Oil Content, Bbls./A. Ft.	775.
Average Oil Recovery, Bbls./A. Ft.	344.
Average Residual Oil Content, Bbls./A. Ft.	431.
Total Original Oil Content, Bbls./Acre	3,526.
Total Oil Recovery, Bbls./Acre	1,567.
Total Residual Oil Content, Bbls./Acre	1,959.
Average Effective Permeability, Millidarcys	3.60
Average Initial Fluid Production Pressure, p.s.i.	22.0

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 Walter Ives Oil Company Lease Earl McGrew Well No. 1

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	492.83	15,980			
2	494.23	17,290			
3	495.62	19,800			
4	496.63	20,860			
5	497.62	16,280			
6	498.91	21,360			
7	500.15	18,300			
8	501.35	17,310			
9	502.26	19,540			
10	503.50	19,510			
11	504.67	16,660			
12	506.07	17,390			
13	507.18	21,800			
14	508.20	17,240			
15	509.08	20,300			
16	510.13	23,500			
17	511.03	18,940			
18	512.35	23,000			

Note: ppm - parts per million.

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Walter Ives Oil Company Lease Earl McGrew Well No. 1

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
492.40 - 498.20	18,041		
498.20 - 512.55	19,422		
492.40 - 512.55	19,025		

Note: ppm - parts per million.