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

OILFIELD RESEARCH LABORATORIES

813 EAST SIXTH
OKMULGEE, OKLAHOMA
PHONE: 1486

- REGISTERED ENGINEERS -
Chanute, Kansas

536 N. HIGHLAND
CHANUTE, KANSAS
PHONE: 728

September 23, 1959

Jackson Brothers
514 North Main
Eureka, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the 3½" Rotary core taken from the Harry Jackson Lease, Well No. 4, Greenwood County, Kansas, and submitted to our laboratory on September 16, 1959.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:cs

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GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Harry Jackson Well No. 4

Location 330' S. of N. Line & 600' W. of E. Line, SW¼

Section 11 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2283.0
Bottom of Core	2322.5
Top of Sand	2311.6
Bottom of Sand	2319.6
Total Feet of Permeable Sand	13.2
Total Feet of Floodable Sand	5.4

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 1	3.6	3.6
1 - 2	2.3	5.9
2 - 4	3.7	9.6
4 & above	3.6	13.2

Average Permeability Millidarcys	2.9
Average Percent Porosity	16.2
Average Percent Oil Saturation	26.4
Average Percent Water Saturation	57.7
Average Oil Content, Bbls./A. Ft.	332.
Total Oil Content, Bbls./Acre	4,820.
Average Percent Oil Recovery by Laboratory Flooding Tests	11.3
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	153.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	828.
Total Calculated Oil Recovery, Bbls./Acre	890.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

A fresh water mud was used as a circulating fluid in the coring of the sand in this well.

The core was sampled and the samples were sealed in cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
2283.0 - 2305.0	Sandy shale (Discarded at well).
2305.0 - 2307.6	Sandy shale.
2307.6 - 2310.0	Light brown shaley sandstone.
2310.0 - 2311.0	Light brown and gray shaley sandstone.
2311.0 - 2314.0	Light brown shaley sandstone.
2314.0 - 2314.2	Gray sandy shale.
2314.2 - 2321.3	Light brown shaley sandstone.
2321.3 - 2321.5	Gray shaley sandstone.
2321.5 - 2322.5	Light brown shaley sandstone.

Coring was started at a depth of 2283.0 feet in sandy shale and completed at 2322.5 feet in light brown shaley sandstone. This core shows a total of 14.7 feet of sandstone. For the most part, the pay is made up of light brown shaley 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 2.8 and 2.9 millidarcys respectively; the overall average being 2.9 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 7.5 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly low weighted average percent oil saturation, namely, 26.4. The weighted average percent oil saturation of the upper and lower sections is 26.3 and 26.5 respectively. The weighted average percent water saturation of the upper and lower sections is 59.4 and 56.5 respectively; the overall average being 57.7 (See Table III). This gives an overall weighted average total fluid saturation of 84.1 percent. This low total fluid saturation indicates considerable fluid was lost during which was probably oil.

The weighted average oil content of the upper and lower sections is 325 and 338 barrels per acre foot respectively; the overall average being 332. The total oil content, as shown by this core, is 4,820 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Part of the sand in this core responded very well to laboratory flooding tests, as a total recovery of 828 barrels of oil per acre was obtained from 5.4 feet of sand. The weighted average percent oil saturation was reduced from 29.1 to 17.8, or represents an average recovery of 11.3 percent. The weighted average effective permeability of the samples is 0.226 millidarcys, while the average initial fluid production pressure is 44.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 15 samples tested, 5 produced water and oil. This indicates that approximately 33 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

On the basis of the above data, it is evident that an efficient water-flood, within the vicinity of this well, will recover approximately 890 barrels of oil per acre or an average of 165 barrels per acre foot

from the 5.4 feet of floodable pay sand analyzed. In calculating this oil recovery value, the following factors and assumptions were employed:

Original formation volume factor	1.10
Present formation volume factor	1.03
True water saturation, percent	40.0
Primary oil recovery, percent	12.0
Present oil saturation, percent	44.2
Oil saturation at abandonment, percent	20.0
Percent porosity	16.2
Net feet of floodable sand	5.4
Performance factor (permeability distribution and sweep efficiency)	0.56

This core shows a thin pay sand section having a fairly low oil saturation, a high water saturation and a low permeability. Chances are, the fairly low oil and high water saturations are partly due to the expansion of gas carried in solution by the oil. Naturally, when the gas forces oil from the sand, water has a tendency to replace the oil.

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RESULTS OF PERMEABILITY TESTS

TABLE I

Company Jackson Brothers Lease Harry Jackson Well No. 4

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	2307.9	Imp.	0.6	0.6	0.00
2	2308.4	0.34	0.5	1.1	0.17
3	2308.9	0.44	0.5	1.6	0.22
4	2309.4	1.1	0.5	2.1	0.55
5	2309.9	Imp.	0.3	2.4	0.00
6	2310.4	0.47	0.6	3.0	0.28
7	2310.9	Imp.	0.4	3.4	0.00
8	2311.4	7.5	0.6	4.0	4.50
9	2311.9	3.4	0.6	4.6	2.04
10	2312.4	4.6	0.5	5.1	2.30
11	2312.9	5.8	0.5	5.6	2.90
12	2313.4	1.8	0.8	6.4	1.44
13	2314.3	0.42	0.4	6.8	0.17
14	2314.9	1.6	0.6	7.4	0.96
15	2315.4	3.5	0.5	7.9	1.75
16	2315.9	3.5	0.5	8.4	1.75
17	2316.4	5.5	0.5	8.9	2.75
18	2316.9	5.5	0.5	9.4	2.75
19	2317.4	6.6	0.5	9.9	3.30
20	2317.9	7.6	0.5	10.4	3.80
21	2318.4	2.3	0.5	10.9	1.15
22	2318.9	2.2	0.5	11.4	1.10
23	2319.4	2.8	0.5	11.9	1.40
24	2319.9	0.94	0.5	12.4	0.47
25	2320.4	0.59	0.5	12.9	0.29
26	2320.9	0.54	0.6	13.5	0.32
27	2321.4	Imp.	0.2	[illegible]	0.00
28	2321.9	2.0	0.6	[illegible]	1.20
29	2322.4	1.0	0.4	14.7	0.40

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RESULTS OF SATURATION TESTS

TABLE II

Company Jackson Brothers Lease Harry Jackson Well No. 4

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	2308.1	14.1	20	71	91	219	1.0	1.0	219
2	2309.1	15.9	20	58	78	247	1.4	2.4	346
3	2310.1	14.8	33	60	93	379	1.0	3.4	379
4	2311.1	16.7	20	54	74	259	0.6	4.0	155
5	2312.1	16.7	36	54	90	467	1.0	5.0	467
6	2313.1	16.9	28	58	86	367	1.4	6.4	514
7	2314.5	16.9	16	56	72	210	0.6	7.0	126
8	2315.1	17.1	23	56	79	305	0.8	7.8	244
9	2316.1	15.8	23	57	80	282	1.0	8.8	282
10	2317.1	17.6	25	53	78	341	1.0	9.8	341
11	2318.1	16.3	31	60	91	392	1.0	10.8	392
12	2319.1	17.7	34	54	88	467	1.0	11.8	467
13	2320.1	15.3	30	59	89	356	1.0	12.8	356
14	2321.1	12.4	26	63	89	250	0.7	13.5	175
15	2322.1	18.4	25	52	77	357	1.0	14.5	357
							Total-	- - - - - -	- 4,820

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Brothers Lease Harry Jackson Well No. 4

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
2308.2 - 2314.0	5.1	2.8	14.40
2314.2 - 2322.5	8.1	2.9	23.56
2308.2 - 2322.5	13.2	2.9	37.96

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
2307.6 - 2314.0	6.4	15.9	26.3	59.4	325	2,080
2314.2 - 2322.5	8.1	16.5	26.5	56.5	338	2,740
2307.6 - 2322.5	14.5	16.2	26.4	57.7	332	4,820

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Harry Jackson Well No. 4

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	2308.1	14.5	18	203	0	0	18	74	203	0	Imp.	50+
2	2309.1	16.3	17	215	0	0	17	71	215	0	Imp.	50+
3	2310.1	14.2	30	331	0	0	30	66	331	0	Imp.	50+
4	2311.1	16.2	18	226	0	0	18	63	226	0	Imp.	50+
5	2312.1	17.1	36	477	20	265	16	78	212	6	0.197	40
6	2313.1	17.3	28	376	13	175	15	76	201	11	0.300	40
7	2314.5	16.6	17	220	0	0	17	62	220	0	Imp.	50+
8	2315.1	16.9	20	262	0	0	20	65	262	0	Imp.	50+
9	2316.1	16.4	23	293	4	51	19	77	242	8	0.307	50
10	2317.1	17.8	25	345	5	69	20	73	276	2	0.100	50
11	2318.1	15.8	28	343	0	0	28	67	343	0	Imp.	50+
12	2319.1	18.2	34	480	14	198	20	76	282	10	0.197	40
13	2320.1	14.9	28	324	0	0	28	64	324	0	Imp.	50+
14	2321.1	12.8	23	228	0	0	23	68	228	0	Imp.	50+
15	2322.1	18.1	23	323	0	0	23	57	323	0	Imp.	50+

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 Jackson Brothers Lease Harry Jackson Well No. 4

Depth Interval, Feet	2311.6 - 2314.0	2315.6 - 2319.6	2311.6 - 2319.6
Feet of Core Analyzed	2.4	3.0	5.4
Average Percent Porosity	17.2	17.5	17.4
Average Percent Original Oil Saturation	31.3	27.4	29.1
Average Percent Oil Recovery	15.9	7.7	11.3
Average Percent Residual Oil Saturation	15.4	19.7	17.8
Average Percent Residual Water Saturation	76.9	75.3	76.0
Average Percent Total Residual Fluid Saturation	92.3	95.0	93.8
Average Original Oil Content, Bbls./A. Ft.	418.	373.	393.
Average Oil Recovery, Bbls./A. Ft.	212.	106.	153.
Average Residual Oil Content, Bbls./A. Ft.	206.	267.	240.
Total Original Oil Content, Bbls./Acre	1,004.	1,118.	2,122.
Total Oil Recovery, Bbls./Acre	510.	318.	828.
Total Residual Oil Content, Bbls./Acre	494.	800.	1,294.
Average Effective Permeability, Millidarcys	0.257.	0.201	0.226
Average Initial Fluid Production Pressure, p.s.i.	40.0	46.7	44.0

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