OILFIELD RESEARCH LABORATORIES
536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

October 5, 1967

Jackson Brothers
514 North Main
Eureka, Kansas 67045

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Teichgraeber Lease, Well No. 6, Greenwood County, Kansas, and submitted to our laboratory on September 27 and 28, 1967.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:bjo

6 c. - Eureka, Kansas

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GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Teichgraeber Well No. 6

Location 330' WEL and 330' NSL, SW/4

Section 14 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2371.0
Bottom of Core	2401.0
Top of Sand	2380.6
Bottom of Sand	2392.2
Total Feet of Permeable ~~Sand~~ Formation	10.9
Total Feet of Floodable Sand	10.2

Distribution of Permeable ~~Sand~~ Formation:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	4.3	4.3
10 - 40	4.6	8.9
40 & above	2.0	10.9

Average Permeability Millidarcys	21.7
Average Percent Porosity	17.7
Average Percent Oil Saturation	32.4
Average Percent Water Saturation	48.2
Average Oil Content, Bbls./A. Ft.	435.
Total Oil Content, Bbls./Acre	5,053.
Average Percent Oil Recovery by Laboratory Flooding Tests	9.3
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	136.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,390.
Total Calculated Oil Recovery, Bbls./Acre - (Primary & Secondary)	2,958.
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. This well was drilled in a virgin area. The core was sampled and sealed in tin cans by an employee of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
2371.0 - 2380.0	Sandy shale (discarded at well).
2380.0 - 2380.6	Dark shale.
2380.6 - 2386.0	Light brown sandstone.
2386.0 - 2387.4	Light brown conglomeratic sandstone.
2387.4 - 2392.2	Grayish brown sandstone.
2392.2 - 2392.4	Dark shale.
2392.4 - 2401.0	Shale (discarded at well).

Coring was started at a depth of 2371.0 feet in sandy shale and completed at 2401.0 feet in shale. This core shows a total of 11.6 feet of sandstone. For the most part, the pay is made up of grayish to light brown 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 34.7 and 9.0 millidarcys respectively; the overall average being 21.7 (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 5.7 to a maximum of 52. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fair weighted average percent oil saturation, namely, 32.4. The weighted average percent oil saturation of the upper and lower sections is 30.8 and 33.6 respectively. The weighted average percent water saturation of the upper and lower sections is 43.5 and 52.4 respectively; the overall average being 48.2 (See Table III). This gives an overall weighted average total fluid saturation of 80.6 percent. This fairly low total fluid saturation indicates some 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. The results of these tests are given in Tables VI and VII. From the data given in these tables and on the coregraph, it is evident that considerable flushing of the sand did occur during coring as the zones of higher permeability had the lower chloride content.

The weighted average oil content of the upper and lower sections is 472 and 404 barrels per acre foot respectively; the overall average being 435. The total oil content, as shown by this core is 5,053 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

When taking into consideration that the sand in the core has only a fair oil saturation, the samples responded very well to laboratory flooding tests, as a total recovery of 1,390 barrels of oil per acre was obtained from 10.2 feet of sand. The weighted average percent oil saturation was reduced from 30.7 to 21.4, or represents an average recovery of 9.3 percent. The weighted average effective permeability of the samples is 1.41 millidarcys, while the average initial fluid production pressure is 23.1 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 11 samples tested, 9 produced water & oil. This indicates approximately 82 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

On the basis of the above data, we estimate that approximately 2,958 barrels of oil per acre or an average of 290 barrels a foot can be recovered from the area, represented by this core, by efficient primary and water flood operations. The following data and assumptions were used in calculating the above recovery value:

Original formation volume factor	1.22
Irreducible water saturation, percent	33.0
Primary recovery, estimated, percent	None
Present oil saturation, percent	54.9
Average porosity, percent	18.6
Oil saturation after flooding, percent	21.4
Performance factor	0.60
Net floodable pay sand, feet	10.2

This core shows a rather thin sand section having a fair oil saturation, a somewhat high water saturation and a good permeability. The chloride tests indicate considerable flushing of the sand occurred during the coring operation. This partly accounts for the fair oil and rather high water saturations.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers Lease Teichgraeber Well No. 6

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	2381.1	19.5	23	43	66	346	52.	1.0	1.0	346	52.00
2	2382.1	20.8	33	43	76	531	42.	1.0	2.0	531	42.00
3	2383.1	19.3	30	45	75	449	22.	1.0	3.0	449	22.00
4	2384.1	20.3	34	45	79	536	25.	1.0	4.0	536	25.00
5	2385.1	19.2	33	42	75	491	33.	1.4	5.4	687	46.20
6	2386.1	13.2	38	50	88	388	3.7	0.7	6.1	299	2.85
7	2387.1	10.0	42	54	96	334	Imp.	0.7	6.8	257	0.00
8	2388.1	16.9	28	47	75	367	18.	1.2	8.0	440	21.60
9	2389.1	16.1	23	54	77	287	6.8	1.0	9.0	287	6.80
10	2390.1	17.4	31	53	84	418	5.7	1.0	10.0	418	5.70
11	2391.1	17.5	37	53	90	502	7.8	1.6	11.6	803	12.48

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Teichgraeber Well No. 6

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	2381.1	19.9	23	355	5	77	18	68	278	64	1.40	20
2	2382.1	20.3	33	519	11	173	22	70	346	55	1.40	25
3	2383.1	19.7	30	459	7	107	23	63	352	66	1.50	20
4	2384.1	19.9	34	525	11	170	23	71	355	54	1.30	20
5	2385.1	19.4	33	497	13	196	20	71	301	101	2.90	20
6	2386.1	13.0	35	353	0	0	35	55	353	0	Imp.	-
7	2387.1	10.4	40	323	0	0	40	58	323	0	Imp.	-
8	2388.1	16.4	28	357	4	51	24	54	306	13	0.40	30
9	2389.1	16.6	23	297	2	26	21	65	271	16	0.40	30
10	2390.1	17.4	31	418	9	121	22	76	297	24	0.67	25
11	2391.1	18.0	37	517	17	238	20	77	279	73	2.00	20

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 PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Brothers Lease Teichgraeber Well No. 6

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
2380.6 - 2386.0	5.4	34.7	187.20
2386.0 - 2392.2	5.5	9.0	49.43
2380.6 - 2392.2	10.9	21.7	236.63

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
2380.6 - 2386.0	5.4	19.8	30.8	43.5	472.	2,549
2386.0 - 2392.2	6.2	16.0	33.6	52.4	404.	2,504
2380.6 - 2392.2	11.6	17.7	32.4	48.2	435.	5,053

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Jackson Brothers Lease Teichgraeber Well No. 6

Depth Interval, Feet	2380.6 - 2386.0	2386.0 - 2392.2	2380.6 - 2392.2
Feet of Core Analyzed	5.4	4.8	10.2
Average Percent Porosity	19.8	17.2	18.6
Average Percent Original Oil Saturation	30.8	30.6	30.7
Average Percent Oil Recovery	9.7	9.0	9.3
Average Percent Residual Oil Saturation	21.1	21.6	21.4
Average Percent Residual Water Saturation	68.8	68.5	68.7
Average Percent Total Residual Fluid Saturation	89.9	90.1	90.1
Average Original Oil Content, Bbls./A. Ft.	472.	411.	443.
Average Oil Recovery, Bbls./A. Ft.	148.	123.	136.
Average Residual Oil Content, Bbls./A. Ft.	324.	288.	307.
Total Original Oil Content, Bbls./Acre	2,552.	1,970.	4,523.
Total Oil Recovery, Bbls./Acre	801.	589.	1,390.
Total Residual Oil Content, Bbls./Acre	1,752.	1,381.	3,133.
Average Effective Permeability, Millidarcys	1.78	0.99	1.42
Average Initial Fluid Production Pressure, p.s.i.	22.5	25.5	23.1

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

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RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VI

Company Jackson Brothers Lease Teichgraeber Well No. 6

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2381.1	13,680			
2	2382.1	12,700			
3	2383.1	8,910			
4	2384.1	16,475			
5	2385.1	23,790			
6	2386.1	120,700			
7	2387.1	96,150			
8	2388.1	69,300			
9	2389.1	77,350			
10	2390.1	89,900			
11	2391.1	102,500			

Note: ppm — parts per million

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Brothers Lease Teichgraeber Well No. 6

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
2380.6 - 2386.0	15,750		
2386.0 - 2392.2	91,300		
2380.6 - 2392.2	56,100		

Note: ppm — parts per million.