



OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

September 28, 1968

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. 7, Greenwood County, Kansas, and submitted to our laboratory on September 20, 1968.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:dp

6 c. - Eureka, Kansas

- REGISTERED ENGINEERS -

CORE ANALYSIS - WATER ANALYSIS - REPRESSURING ENGINEERING - SURVEYING & MAPPING - PROPERTY EVALUATION & OPERATION

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GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Teichgraeber Well No. 7

Location NE SE SW

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

Name of Sand	Bartlesville
Top of Core	2383.0
Bottom of Core	2403.0
Top of ^{Pay} Sand	2388.0
Bottom of Sand	2396.5
Total Feet of Permeable Sand	13.5
Total Feet of Floodable Sand	8.5

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 3	5.0	5.0
3 - 10	4.7	9.7
10 - 15	1.8	11.5
15 & above	2.0	13.5

Average Permeability Millidarcys	7.5
Average Percent Porosity	17.1
Average Percent Oil Saturation	26.8
Average Percent Water Saturation	50.0
Average Oil Content, Bbls./A. Ft.	355.
Total Oil Content, Bbls./Acre	4,788.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	97.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	822.
Total Calculated Oil Recovery, Bbls./Acre - (Primary & Secondary)	2,592.
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 plastic bags by a representative of Oilfield Research Laboratories. The core was removed from the core barrel approximately 3 hours before it was sampled.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
2383.0 - 2388.0	Light brown fine grained micaceous shaly sandstone.
2388.0 - 2396.5	Light brown fine grained micaceous slightly shaly sandstone.
2396.5 - 2403.0	Dark shale.

Coring was started at a depth of 2383.0 feet in light brown fine grained micaceous shaly sandstone and completed at 2403.0 feet in dark shale. This core shows a total of 13.5 feet of sandstone. For the most part, the pay is made up of light brown fine grained micaceous slightly shaly 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 0.79 and 11.5 millidarcys respectively; the overall average being 7.5 (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 0.27 to a maximum of 34. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly low weighted average percent oil saturation, namely, 26.8. The weighted average percent oil saturation of the upper and lower sections is 28.8 and 25.8 respectively. The weighted average percent water saturation of the upper and lower sections is 52.5 and 48.6 respectively; the overall average being 50.0 (See Table III). This gives an overall weighted average total fluid saturation of 76.8 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 pay sand section (2388.0 to 2396.5) occurred during the coring operation as the chloride content of this zone is much lower than the upper section.

The weighted average oil content of the upper and lower sections is 344 and 361 barrels per acre foot respectively; the overall average being 355. The total oil content, as shown by this core, is 4,788 barrels per acre of which 3,067 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The pay sand in this core responded very well to laboratory flooding tests, as a total recovery of 822 barrels of oil per acre was obtained from

8.5 feet of sand. The weighted average percent oil saturation was reduced from 25.8 to 19.0, or represents an average recovery of 6.8 percent. The weighted average effective permeability of the samples is 1.45 millidarcys, while the average initial fluid production pressure is 23.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 14 samples tested, 9 produced water and oil. This indicates that approximately 64 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

From a study of the above data, we estimate that approximately 2,592 barrels of oil per acre or an average of 305 barrels per acre-foot can be recovered from the area, represented by this core, by efficient primary and waterflood operations. The following data and assumptions were used in calculating the above oil recovery value:

Present formation volume factor	1.20
Irreducible water saturation, percent	30.0
Primary recovery, estimated, percent	None
Present oil saturation, percent	58.3
Average porosity, percent	18.2
Oil saturation after flooding, percent	19.0
Performance factor, percent	50.0
Net floodable pay sand, feet	8.5

This core shows a rather clean pay sand section (2388.0 to 2396.5 feet) having a fairly low oil saturation, a moderate water saturation

and fairly good porosity and permeability. No doubt, considerable flushing of the sand (in the core) occurred during the cutting of same and this could partly account for lower oil and higher water saturations.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers Lease Teichgraeber Well No. 7

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			Ft.	Cum. Ft.		
1	2383.3	15.9	29	52	358	0.27	0.8	0.8	286	0.22
2	2384.3	15.4	22	55	263	0.72	1.0	1.8	263	0.72
3	2385.3	14.0	28	55	304	1.2	1.0	2.8	304	1.20
4	2386.3	15.7	32	51	390	1.4	1.0	3.8	390	1.40
5	2387.3	16.0	32	50	397	0.35	1.2	5.0	478	0.42
6	2388.3	17.0	22	49	290	3.0	0.8	5.8	232	2.40
7	2389.3	18.6	32	49	462	5.4	1.0	6.8	462	5.40
8	2390.3	17.6	35	48	478	12.	1.0	7.8	478	12.00
9	2391.3	18.0	23	45	321	8.3	1.0	8.8	321	8.30
10	2392.3	15.4	29	59	346	6.7	1.0	9.8	346	6.70
11	2393.3	18.3	27	49	383	34.	1.0	10.8	383	34.00
12	2394.3	19.3	26	42	389	15.	1.0	11.8	389	15.00
13	2395.3	18.6	18	51	260	6.8	0.9	12.7	234	6.12
14	2396.1	21.0	17	45	277	10.	0.8	13.5	222	8.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Lease	Well No.			
Jackson Brothers	Teichgraeber	7			
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.		
2383.0 - 2388.0	5.0	0.79	3.96		
2388.0 - 2396.5	8.5	11.5	97.92		
2383.0 - 2396.5	13.5	7.5	101.88		
Depth Interval, Feet	Feet of Core Analyzed	Average Percent Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
2383.0 - 2388.0	5.0	15.4	28.8	344	1,721
2388.0 - 2396.5	8.5	18.2	25.8	361	3,067
2383.0 - 2396.5	13.5	17.1	26.8	355	4,788

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

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			
1	2383.3	15.5	27	325	0	0	27	60	0	Imp.	-
2	2384.3	15.6	20	242	0	0	20	63	0	Imp.	-
3	2385.3	14.5	25	281	0	0	25	63	0	Imp.	-
4	2386.3	15.4	29	347	0	0	29	57	0	Imp.	-
5	2387.3	15.7	30	366	0	0	30	56	0	Imp.	-
6	2388.3	16.5	22	282	2	26	20	78	15	0.44	30
7	2389.3	18.1	32	449	9	126	23	76	35	0.90	25
8	2390.3	18.0	35	489	14	196	21	70	32	0.80	20
9	2391.3	18.1	23	323	7	98	16	78	66	1.50	20
10	2392.3	15.9	29	357	4	49	25	73	16	0.50	30
11	2393.3	18.5	27	388	11	158	16	82	32	1.10	25
12	2394.3	19.7	26	297	8	122	18	81	95	3.50	20
13	2395.3	18.5	18	259	2	29	16	77	34	0.90	25
14	2396.1	21.4	17	282	2	33	15	79	99	3.60	20

Company Jackson Brothers Lease Teichgraeber Well No. 7

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 <u>Jackson Brothers</u>	Lease <u>Teichgraeber</u>	Well No. <u>7</u>
Depth Interval, Feet	2388.0 - 2396.5	
Feet of Core Analyzed	8.5	
Average Percent Porosity	18.3	
Average Percent Original Oil Saturation	25.8	
Average Percent Oil Recovery	6.8	
Average Percent Residual Oil Saturation	19.0	
Average Percent Residual Water Saturation	77.0	
Average Percent Total Residual Fluid Saturation	96.0	
Average Original Oil Content, Ebbls./A. Ft.	363.	
Average Oil Recovery, Ebbls./A. Ft.	97.	
Average Residual Oil Content, Ebbls./A. Ft.	266.	
Total Original Oil Content, Ebbls./Acre	3,087.	
Total Oil Recovery, Ebbls./Acre	822.	
Total Residual Oil Content, Ebbls./Acre	2,265.	
Average Effective Permeability, Millidarcys	1.45	
Average Initial Fluid Production Pressure, p.s.i.	23.8	

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. 7

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation	
			Connate	Drilling & Foreign Total
1	2383.3	97,300		
2	2384.3	102,100		
3	2385.3	112,200		
4	2386.3	106,300		
5	2387.3	104,400		
6	2388.3	79,700		
7	2389.3	51,000		
8	2390.3	75,300		
9	2391.3	68,200		
10	2392.3	105,700		
11	2393.3	95,700		
12	2394.3	46,900		
13	2395.3	99,000		
14	2396.1	60,200		

Note: ppm — parts per million

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Brothers Lease Teichgraeber Well No. 7

<u>Depth Interval, Feet</u>	<u>Chloride Content of Brine in Sand, ppm</u>	<u>Average Percent Connate Water</u>	<u>Average Percent Drilling & Foreign Water</u>
2383.0 - 2388.0	104,740		
2388.0 - 2396.5	75,541		
2383.0 - 2396.5	86,481		

Note: ppm — parts per million.