OILFIELD RESEARCH LABORATORIES

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

July 20, 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 Barrier Lease, Well No. 37, Greenwood County, Kansas, and submitted to our laboratory on July 16, 1967.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

Benjamin R. Pearman

BRP:rf

6 c.

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Barrier Well No. 37

Location CEL SW SW

Section 3 Twp. 26S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2417.0
Bottom of Core	2492.0
Top of Sand (Analyzed)	2417.0
Bottom of Sand (Tested)	2488.9
Total Feet of Permeable Sand	18.5
Total Feet of Floodable Sand	16.5

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	4.8	4.8
10 - 20	5.5	10.3
20 - 50	5.9	16.2
50 & above	2.3	18.5

Average Permeability Millidarcys	21.4
Average Percent Porosity	18.1
Average Percent Oil Saturation	24.2
Average Percent Water Saturation	60.4
Average Oil Content, Bbls./A. Ft.	353.
Total Oil Content, Bbls./Acre	7,639.
Average Percent Oil Recovery by Laboratory Flooding Tests	4.7
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	71.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,170.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	3,760.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories. The well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
2417.0 - 2417.3	Grayish light brown, laminated, shaly sandstone.
2417.3 - 2418.0	Gray shale.
2418.0 - 2420.1	Gray, laminated, shaly sandstone.
2420.1 - 2421.9	Brown sandstone.
2421.9 - 2422.7	Shale.
2422.7 - 2423.7	Brown sandstone.
2423.7 - 2424.2	Shale.
2424.2 - 2424.7	Brown sandstone.
2424.7 - 2425.0	Shale.
2425.0 - 2430.1	Brown sandstone.
2430.1 - 2431.3	Shale.
2431.3 - 2431.8	Brown sandstone.
2431.8 - 2434.0	Shale.
2434.0 - 2435.7	Brown sandstone.
2435.7 - 2436.2	Brown sandstone with thin carbonaceous streaks.
2436.2 - 2437.9	Brown sandstone.
2437.9 - 2438.3	Brown, laminated, shaly sandstone.
2438.3 - 2442.0	Brown sandstone.
2442.0 - 2442.2	Coal.

2442.2 - 2463.0 - Gray sandy shale.

2463.0 - 2467.0 - Shale.

2479.0 - 2486.6 - Shale.

2486.6 - 2488.9 - Gray shaly sandstone.

2488.9 - 2492.0 - Shale.

Coring was started at a depth of 2417.0 feet in shaly sandstone and completed at 2492.0 feet in shale. This core shows a total of 21.6 feet of sandstone. For the most part, the pay is made up of brown sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 14.1, 32.9 and 0.50 millidarcys respectively; the overall average being 21.4 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 62. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 24.2. The weighted average percent oil saturation of the upper, middle and lower sections is 24.0, 28.9 and 9.2 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 58.6, 55.0 and 86.6 respectively; the overall average being 60.4 (See Table III). This gives an overall weighted average total fluid saturation of 84.6 percent.

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 some flushing of the core did occur. The zones of higher permeability show the lower chloride content.

The weighted average oil content of the upper, middle and lower sections is 352, 426 and 110 barrels per acre foot respectively; the overall average being 353. The total oil content, as shown by this core, is 7,639 barrels per acre of which 6,832 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 1,170 barrels of oil per acre was obtained from 16.5 feet of sand. The weighted average percent oil saturation was reduced from 27.9 to 23.2, or represents an average recovery of 4.7 percent. The weighted average effective permeability of the samples is 1.44 millidarcys, while the average initial fluid production pressure is 23.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 21 samples tested, 19 produced water and 17 oil. This indicates that approximately 81 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a wide variation in effective permeability to water.

CONCLUSION

The results of the laboratory tests indicate that efficient primary

and secondary operations in the vicinity of this well should recover approximately 3,760 barrels of oil per acre or an average of 228 barrels per acre foot from the 16.5 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.23
Reservoir water saturation, percent	39.0
Average porosity, percent	19.2
Oil saturation after flooding, percent	23.2
Performance factor, percent	50.0
Net floodable pay sand, feet	16.5

This core shows a pay sand section having a good oil saturation, a moderate water saturation and a wide variation in effective permeability to water.

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers Lease Barrier Well No. 37

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	2417.1	13.6	11	82	93	116	Imp.	0.3	0.3	35	0.00
2	2418.1	20.6	19	55	74	304	3.1	0.6	0.9	182	1.86
3	2419.1	11.1	12	76	88	103	Imp.	1.5	2.4	155	0.00
4	2420.2	18.9	29	52	81	425	9.0	0.5	2.9	213	4.50
5	2421.1	17.2	30	58	88	401	6.8	1.3	4.2	521	8.84
6	2423.1	16.0	24	68	92	298	15.	1.0	5.2	298	15.00
7	2424.3	19.9	21	53	74	324	17.	0.5	5.7	162	8.50
8	2425.1	20.7	32	51	83	670	12.	0.6	6.3	402	7.20
9	2426.1	18.6	22	58	80	317	9.5	1.0	7.3	317	9.50
10	2427.1	19.6	25	54	79	380	14.	1.0	8.3	380	14.00
11	2428.1	19.6	28	53	81	426	14.	1.0	9.3	426	14.00
12	2429.1	20.3	29	48	77	457	26.	1.5	10.8	685	39.00
13	2431.4	19.7	26	55	81	397	23.	0.5	11.3	199	11.50
14	2434.3	20.2	24	55	79	376	46.	0.6	11.9	226	27.60
15	2435.1	20.4	23	49	72	364	21.	1.1	13.0	400	23.10
16	2436.1	16.9	32	60	92	420	24.	0.5	13.5	210	12.00
17	2437.1	17.2	37	59	96	494	29.	1.7	15.2	840	49.40
18	2438.1	15.5	21	60	81	252	1.6	0.4	15.6	102	0.64
19	2439.1	20.9	31	51	82	503	55.	1.3	16.9	654	71.50
20	2440.1	19.0	33	57	90	486	62.	1.0	17.9	486	62.00
21	2441.1	20.6	22	54	76	352	12.	1.4	19.3	493	16.80
22	2486.8	15.3	4	91	95	47	Imp.	0.5	19.8	24	0.00
23	2487.9	16.2	12	84	96	151	0.50	1.0	20.8	151	0.50
24	2488.8	13.9	9	87	96	97	Imp.	0.8	21.6	78	0.00
								Total	-------	7,639	

Oilfield Research Laboratories

SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Brothers Lease Barrier Well No. 37

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
2417.0 - 2431.8	9.5	14.1	133.90
2434.0 - 2442.0	8.0	32.9	263.04
2486.6 - 2488.9	1.0	0.50	0.50
2417.0 - 2488.9	18.5	21.4	397.44

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
2417.0 - 2431.8	11.3	17.8	24.0	58.6	352	3,975
2434.0 - 2442.0	8.0	19.2	28.9	55.0	426	3,411
2486.6 - 2488.9	2.3	15.2	9.2	86.6	110	253
2417.0 - 2488.9	21.6	18.1	24.2	60.4	353	7,639

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Barrier Well No. 37

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	2417.1	14.0	10	109	0	0	10	83	109	0	Imp.	-
2	2418.1	20.2	19	298	0	0	19	57	298	6	0.222	40
3	2419.1	11.0	13	111	0	0	13	77	111	0	Imp.	-
4	2420.2	18.6	29	419	3	43	26	66	376	16	0.400	30
5	2421.1	17.7	30	411	4	55	26	68	356	25	0.600	25
6	2423.1	16.5	24	307	2	26	22	76	281	45	1.00	25
7	2424.3	20.3	21	330	2	31	19	70	299	45	1.00	25
8	2425.1	20.3	32	503	8	126	24	66	377	29	0.800	25
9	2426.1	18.8	22	321	2	29	20	66	292	42	1.00	20
10	2427.1	19.2	25	373	5	75	20	71	298	30	0.700	25
11	2428.1	19.4	28	421	7	105	21	75	316	23	0.600	25
12	2429.1	20.2	29	454	7	110	22	76	344	102	2.70	20
13	2431.4	19.3	26	389	5	75	21	65	314	27	0.700	25
14	2434.3	20.5	24	381	4	64	20	78	317	125	3.80	20
15	2435.1	20.2	23	360	5	78	18	70	282	45	1.00	20
16	2436.1	16.5	32	410	4	51	28	67	359	17	0.400	30
17	2437.1	17.5	37	501	4	54	33	63	447	73	1.80	20
18	2438.1	16.1	20	250	0	0	20	70	250	11	0.300	30
19	2439.1	20.8	31	500	6	97	25	67	403	82	1.90	20
20	2440.1	19.3	33	494	9	135	24	65	359	112	2.70	20
21	2441.1	20.8	22	354	2	32	20	76	322	70	1.60	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.

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Jackson Brothers Lease Barrier Well No. 37

Depth Interval, Feet	2417.0 - 2431.8	2434.0 - 2442.0	2417.0 - 2442.0
Feet of Core Analyzed	8.9	7.6	16.5
Average Percent Porosity	18.9	19.5	19.2
Average Percent Original Oil Saturation	26.9	29.4	27.9
Average Percent Oil Recovery	4.7	4.8	4.7
Average Percent Residual Oil Saturation	22.2	24.6	23.2
Average Percent Residual Water Saturation	70.9	68.8	70.0
Average Percent Total Residual Fluid Saturation	93.1	93.4	93.2
Average Original Oil Content, Bbls./A. Ft.	394.	436.	414.
Average Oil Recovery, Bbls./A. Ft.	70.	72.	71.
Average Residual Oil Content, Bbls./A. Ft.	324.	364.	343.
Total Original Oil Content, Bbls./Acre	3,511.	3,321.	6,832.
Total Oil Recovery, Bbls./Acre	624.	546.	1,170.
Total Residual Oil Content, Bbls./Acre	2,887.	2,775.	5,662.
Average Effective Permeability, Millidarcys	1.09	1.85	1.44
Average Initial Fluid Production Pressure, p.s.i.	24.5	21.4	23.2

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

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VI

Company Jackson Brothers Lease Barrier Well No. 37

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1	2417.1	86,300			
2	2418.1	58.500			
3	2419.1	65,750			
4	2420.2	47,500			
5	2421.1	83,100			
6	2423.1	40,350			
7	2424.3	28,700			
8	2425.1	10,710			
9	2426.1	35,875			
10	2427.1	32,650			
11	2428.1	25,775			
12	2429.1	19,550			
13	2431.4	24,475			
14	2434.3	17,300			
15	2435.1	38,050			
16	2436.1	73,350			
17	2437.1	50,500			
18	2438.1	86,400			
19	2439.1	14,000			
20	2440.1	24,800			
21	2441.1	13,550			

Note: ppm — parts per million

Oilfield Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Brothers Lease Barrier Well No. 37

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
2417.0 - 2431.8	42,200		
2434.0 - 2442.0	39,600		
2417.0 - 2442.0	41,800		

Note: ppm — parts per million.