



OILFIELD RESEARCH LABORATORIES

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

October 10, 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 Jackson-Covert Lease, Well No. 4, Greenwood County, Kansas, and submitted to our laboratory on October 1, 1967.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:bjc

6 c. - Eureka, Kansas

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Jackson-Covert Well No. 4

Location NE, NE, NE

Section 4 Twp. 23S Rge. 10E County Greenwood State Kansas

Name of Sand	Cattleman
Top of Core	2130.0
Bottom of Core	2162.7
Top of ^{Pay} Sand	2136.6
Bottom of Sand	2162.7
Total Feet of Permeable Sand	30.9
Total Feet of Floodable Sand	14.1

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 50	2.8	2.8
50 - 100	8.0	10.8
100 - 200	6.0	16.8
200 - 300	4.0	20.8
300 - 500	4.0	24.8
500 & above	6.1	30.9

Average Permeability Millidarcys	239.6
Average Percent Porosity	22.8
Average Percent Oil Saturation	16.6
Average Percent Water Saturation	61.5
Average Oil Content, Bbls./A. Ft.	283.
Total Oil Content, Bbls./Acre	8,752.
Average Percent Oil Recovery by Laboratory Flooding Tests	3.3
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	57.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	751.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	3,737.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Jackson-Covert Well No. 4

Location NE, NE, NE

Section 4 Twp. 23S Rge. 10E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2112.0
Bottom of Core	2230.0
Top of Sand (Cored)	2212.0
Bottom of Sand	2227.2
Total Feet of Permeable Sand	15.2
Total Feet of Floodable Sand	5.6

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 5	3.6	3.6
5 - 10	2.0	5.6
10 - 20	2.0	7.6
20 - 40	3.0	10.6
40 & above	4.6	15.2

Average Permeability Millidarcys	30.1
Average Percent Porosity	17.3
Average Percent Oil Saturation	20.6
Average Percent Water Saturation	61.6
Average Oil Content, Bbls./A. Ft.	306.
Total Oil Content, Bbls./Acre	4,647.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.2
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	98.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	450.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	1,456.
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 sands in this well. This well was drilled in a virgin area. The cores were sampled and sealed in cans by an employee of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
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<u>CATTLEMAN SAND</u>	
2130.0 - 2131.8	- Shale.
2131.8 - 2136.6	- Gray sandstone.
2136.6 - 2153.6	- Light brown sandstone.
2153.6 - 2157.6	- Soft gray sandstone.
2157.6 - 2162.7	- Light brown sandstone.
2162.7 - 2164.0	- Loss

BARTLESVILLE SAND

2212.0 - 2218.6	- Light brown slightly shaly sandstone.
2218.6 - 2227.2	- Grayish brown to light brown sandstone.
2227.2 - 2230.0	- Shale.

Coring of the Cattleman sand was started at a depth of 2130.0 feet in shale and completed at 2164.0 feet probably in light brown sandstone. There was a 0.3 foot loss at the bottom of the core. This core shows a total of 30.9 feet of sandstone. The coring of the Bartlesville sand was started at 2212.0 feet in light brown slightly shaly sandstone and completed at 2230.0 feet in shale. This core shows a total of 15.2 feet of sandstone.

PERMEABILITY

The weighted average permeability of the Cattleman and Bartlesville sands is 239.6 and 30.1 millidarcys respectively. (See Table III). By observing the data given on the coregraph, it is

noticeable that the sands have very irregular permeability profiles. The permeability of the sands vary from 2.0 to a maximum of 986. millidarcys.

PERCENT SATURATION & OIL CONTENT

The weighted average percent oil saturation of Cattleman and Bartlesville sands is 16.6 and 20.6 respectively. The weighted average percent water saturation of the upper and lower sands is 61.5 and 61.6 respectively. (See Table III). This gives an overall weighted average total fluid saturations of 78.1 and 82.2 percent respectively for the two sands. 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 the Cattleman sand was badly flushed during coring. Considerable flushing of the Bartlesville sand also occurred during coring, especially in the lower part of the sand section. The chloride content of water in the sand samples is much lower than that present in the reservoir.

The weighted average oil content of Cattleman and Bartlesville sands is 283 and 306 barrels per acre foot respectively. The total oil content, as shown by the cores is 13,399 barrels per acre of which 8,752 barrels are in the Cattleman sand core (See Table III).

LABORATORY FLOODING TESTS

When taking into consideration that the sand in the cores have a low oil saturation, one would expect very little, if any, oil to

be recovered by laboratory flooding tests, however, a total recovery of 751 barrels of oil per acre was obtained from 13.1 feet of Cattleman sand. The weighted average percent oil saturation was reduced from 22.5 to 19.2, or represents an average recovery of 3.3 percent. The weighted average effective permeability of the samples is 12.32 millidarcys, while the average initial fluid production pressure is 10.4 pounds per square inch (See Table V). The Bartlesville sand showed a recovery of 450 barrels per acre from 4.6 feet of sand.

By observing the data given in Table IV, you will note that of the 46 samples tested, 45 produced water and 17 oil. This indicates that approximately 37 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

On the basis of the above data, we estimate that approximately 5,193 barrels of oil per acre can be recovered from the areas, represented by the cores, by efficient primary and waterflood operations. This represents 3,737 barrels from the Cattleman and 1,456 from the Bartlesville sand. The following data and assumptions were used in calculating the above oil recovery values:

	Cattleman Sand	Bartlesville Sand
Original formation volume factor	1.22	1.22
Irreducible water saturation, percent	40.0	40.0
Primary recovery, estimated, percent	None	None
Present oil saturation, percent	49.2	49.2
Average porosity, percent	22.8	20.1
Oil saturation after flooding, percent	19.2	18.9
Performance factor	0.50	0.55
Net floodable pay sand, feet	14.1	5.6

The cores show clean sand sections having low oil and high water saturations and a high permeability for the Cattleman sand and an average permeability for the Bartlesville sand. The chloride tests show that considerable flushing of the sand in the cores occurred during coring, especially of the Cattleman sand. This would partly account for the low oil and high water saturations.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers

Lease Jackson-Covert

Well No. 4

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	2132.1	20.5	4	65	CATTLEMAN SAND 64	39.	0.8	0.8	51	31.00
2	2133.1	23.1	3	64	54	165.	1.0	1.8	54	165.00
3	2134.1	24.0	4	66	74	273.	1.0	2.8	74	273.00
4	2135.1	24.3	13	63	245	223.	1.0	3.8	245	223.00
5	2136.1	19.4	18	68	271	99.	1.0	4.8	271	99.00
6	2137.1	21.6	18	51	302	67.	1.0	5.8	302	67.00
7	2138.1	20.9	14	54	226	100.	1.0	6.8	226	100.00
8	2139.1	22.4	20	52	347	84.	1.0	7.8	347	84.00
9	2140.1	23.4	22	53	399	89.	1.0	8.8	399	89.00
10	2141.1	22.6	30	52	526	111.	1.0	9.8	526	111.00
11	2142.1	21.8	19	51	321	79.	1.0	10.8	321	79.00
12	2143.1	21.4	20	54	332	78.	1.0	11.8	332	78.00
13	2144.1	21.3	20	54	330	80.	1.0	12.8	330	80.00
14	2145.1	20.8	26	52	419	64.	1.0	13.8	419	64.00
15	2146.1	4.8	28	65	104	8.7	1.0	14.8	104	8.70
16	2147.1	22.0	19	57	324	137.	1.0	15.8	324	137.00
17	2148.1	20.1	30	64	466	150.	1.0	16.8	466	150.00
18	2149.1	23.4	15	64	272	296.	1.0	17.8	272	296.00
19	2150.1	26.0	20	61	403	390.	1.0	18.8	403	390.00
20	2151.1	25.4	15	66	295	219.	1.0	19.8	295	219.00
21	2152.1	27.1	12	67	252	630.	1.0	20.8	252	630.00
22	2153.1	21.8	12	72	203	576.	1.0	21.8	203	576.00
23	2154.1	27.3	7	73	148	745.	1.0	22.8	148	745.00
24	2155.1	25.4	12	24	236	449.	1.0	23.8	236	449.00
25	2156.1	27.4	6	76	127	986.	1.0	24.8	127	986.00
26	2157.1	27.5	8	73	171	606.	1.0	25.8	171	606.00
27	2158.1	21.5	16	69	266	436.	1.0	26.8	266	436.00

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers Lease Jackson-Covert Well No. 4

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.		
28	2159.1	21.9	19	50	69	322	10.	1.0	27.8	322	10.00
29	2160.1	23.8	26	56	82	479	136.	1.0	28.8	479	136.00
30	2161.1	28.0	15	64	79	326	305.	1.0	29.8	326	305.00
31	2162.1	24.6	22	58	80	419	874.	1.1	30.9	461	961.50
<u>BARTLESVILLE SAND</u>											
32	2212.1	16.9	22	71	93	288	2.0	0.6	31.5	173	1.20
33	2213.1	17.1	23	64	87	305	8.1	1.0	32.5	305	8.10
34	2214.1	17.4	19	63	82	256	5.2	1.0	33.5	256	5.20
35	2215.1	16.3	16	63	79	202	2.6	1.0	34.5	202	2.60
36	2216.1	18.1	28	58	86	392	13.	1.0	35.5	392	13.00
37	2217.1	15.5	16	66	82	192	4.7	1.0	36.5	192	4.70
38	2218.1	18.1	23	63	86	323	4.2	1.0	37.5	323	4.20
39	2219.1	17.0	30	65	95	395	18.	1.0	38.5	395	18.00
40	2220.1	18.0	21	67	88	293	24.	1.0	39.5	293	24.00
41	2221.1	18.1	21	66	87	295	29.	1.0	40.5	295	29.00
42	2222.1	17.7	18	70	88	247	24.	1.0	41.5	247	24.00
43	2223.1	17.7	14	72	86	192	44.	1.0	42.5	192	44.00
44	2224.1	18.9	26	65	91	381	53.	1.0	43.5	381	53.00
45	2225.1	20.6	21	58	79	335	49.	1.0	44.5	335	49.00
46	2226.1	22.4	24	54	78	416	110.	1.6	46.1	666	176.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Lease	Well No.			
Jackson Brothers	Jackson-Covert	4			
<u>Cattleman Sand</u>					
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Fl. x Md.		
2131.8 - 2136.6	4.8	164.8	791.00		
2136.6 - 2150.6	14.0	123.8	1,733.70		
2150.6 - 2162.7	12.1	403.3	4,879.50		
2131.8 - 2162.7	30.9	239.6	7,404.20		
<u>Bartlesville Sand</u>					
2212.0 - 2227.2	15.2	30.1	456.00		
<u>Cattleman Sand</u>					
Depth Interval, Feet	Feet of Core Analyzed	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
2131.8 - 2136.6	4.8	8.6	65.2	145	695
2136.6 - 2150.6	14.0	21.6	56.0	341	4,771
2150.6 - 2162.7	12.1	14.6	66.4	271	3,286
2131.8 - 2162.7	30.9	16.6	61.5	283	8,752
<u>Bartlesville Sand</u>					
2212.0 - 2227.2	15.2	20.6	61.6	306	4,647

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Jackson-Covey 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	2132.1	20.1	5	78	0	0	5	74	78	159	3.70	5
2	2133.1	23.5	2	36	0	0	2	91	36	274	24.00	5
3	2134.1	23.5	6	109	0	0	6	87	109	278	11.50	5
4	2135.1	24.7	10	192	0	0	10	87	192	548	60.00	5
5	2136.1	19.9	14	216	0	0	14	85	216	314	26.25	5
6	2137.1	21.4	18	299	1	17	17	82	282	170	8.00	15
7	2138.1	20.5	16	254	0	0	16	72	254	190	5.40	10
8	2139.1	22.4	20	348	2	35	18	72	313	144	3.80	10
9	2140.1	23.0	22	393	3	54	19	77	339	201	7.50	10
10	2141.1	22.9	30	533	8	142	22	71	391	236	9.80	10
11	2142.1	22.0	19	324	2	34	17	82	290	327	12.40	10
12	2143.1	21.8	20	339	2	34	18	72	305	226	9.20	10
13	2144.1	21.3	20	331	1	17	19	72	314	144	5.70	10
14	2145.1	21.2	26	428	6	99	20	78	329	162	6.90	10
15	2146.1	5.5	24	102	0	0	24	72	102	0	Imp.	10
16	2147.1	22.4	19	330	1	17	18	79	313	332	17.30	5
17	2148.1	20.4	30	475	8	127	22	76	348	181	6.40	10
18	2149.1	23.7	14	258	0	0	14	84	258	227	24.00	5
19	2150.1	26.5	20	411	2	41	18	70	370	279	23.00	5
20	2151.1	25.8	17	340	0	0	17	82	340	268	25.60	5
21	2152.1	27.1	10	210	0	0	10	88	210	460	72.50	5
22	2153.1	21.4	13	216	0	0	13	83	216	258	33.50	5
23	2154.1	27.2	10	216	0	0	10	82	216	228	27.50	5
24	2155.1	25.7	9	180	0	0	9	84	180	200	40.00	5
25	2156.1	27.8	4	86	0	0	4	87	86	231	30.00	5
26	2157.1	28.0	6	130	0	0	6	89	130	283	50.00	5
27	2158.1	22.0	14	239	0	0	14	75	239	453	50.00	5

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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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			
28	2159.1	21.4	17	282	0	0	17	80	129	6.00	10
29	2160.1	23.4	26	472	5	91	21	77	216	10.20	10
30	2161.1	28.4	17	375	0	0	17	76	278	38.40	5
31	2162.1	24.9	22	425	2	39	20	72	269	37.50	5
<u>BARTLESVILLE SAND</u>											
32	2212.1	16.9	19	249	0	0	19	79	6	0.300	40
33	2213.1	17.0	20	264	0	0	20	72	7	0.400	40
34	2214.1	17.1	16	212	0	0	16	75	5	0.300	40
35	2215.1	16.0	18	223	0	0	18	73	5	0.300	40
36	2216.1	18.0	24	335	0	0	24	68	7	0.400	40
37	2217.1	16.0	14	174	0	0	14	78	13	0.375	30
38	2218.1	17.6	22	300	0	0	22	72	20	0.500	30
39	2219.1	17.4	30	486	6	81	24	72	67	1.30	10
40	2220.1	18.5	22	316	0	0	22	77	66	1.50	20
41	2221.1	18.4	19	271	0	0	19	73	49	1.10	20
42	2222.1	18.0	17	237	0	0	17	80	53	1.20	20
43	2223.1	18.1	15	211	0	0	15	84	92	1.90	10
44	2224.1	18.5	26	373	5	72	21	78	130	3.40	10
45	2225.1	21.0	21	342	3	49	18	81	109	3.40	20
46	2226.1	22.2	24	413	9	155	15	74	297	10.80	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.

Company Jackson Brothers

Lease Jackson--Covert

Well No. 4

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Jackson Brothers	Lease	Jackson-Covert	Well No.	4
	<u>Cattleman Sand</u>				<u>Bartlesville Sand</u>
Depth Interval, Feet	2136.6 - 2150.6	2150.6 - 2162.7	2136.6 - 2162.7	2212.0 - 2227.2	
Feet of Core Analyzed	11.0	2.1	13.1	4.6	
Average Percent Porosity	22.3	24.2	22.6	20.1	
Average Percent Original Oil Saturation	22.2	23.9	22.5	25.1	
Average Percent Oil Recovery	3.3	3.4	3.3	6.2	
Average Percent Residual Oil Saturation	18.9	20.5	19.2	18.9	
Average Percent Residual Water Saturation	75.5	74.4	75.4	76.0	
Average Percent Total Residual Fluid Saturation	94.4	94.9	94.6	94.9	
Average Original Oil Content, Bbls./A. Ft.	383.	448.	393.	405.	
Average Oil Recovery, Bbls./A. Ft.	56.	64.	57.	98.	
Average Residual Oil Content, Bbls./A. Ft.	327.	384.	336.	307.	
Total Original Oil Content, Bbls./Acre	4,211.	940.	5,151.	1,862.	
Total Oil Recovery, Bbls./Acre	617.	134.	751.	450.	
Total Residual Oil Content, Bbls./Acre	3,594.	806.	4,400.	1,412.	
Average Effective Permeability, Millidarcys	10.00	24.50	12.32	5.54	
Average Initial Fluid Production Pressure, p.s.i.	10.5	10.0	10.4	15.6	

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 Jackson-Covert Well No. 4

CATTLEMAN SAND

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		Total
			Connate	Drilling & Foreign	
1	2132.1	7,960			
2	2133.1	3,917			
3	2134.1	3,640			
4	2135.1	2,847			
5	2136.1	4,388			
6	2137.1	2,583			
7	2138.1	3,982			
8	2139.1	7,590			
9	2140.1	3,490			
10	2141.1	3,800			
11	2142.1	4,038			
12	2143.1	5,155			
13	2144.1	3,880			
14	2145.1	4,210			
15	2146.1	117,250			
16	2147.1	5,890			
17	2148.1	5,965			
18	2149.1	6,740			
19	2150.1	3,557			
20	2151.1	3,340			
21	2152.1	3,057			
22	2153.1	4,690			
23	2154.1	2,800			
24	2155.1	3,030			
25	2156.1	3,310			
26	2157.1	2,062			
27	2158.1	3,010			
28	2159.1	39,350			
29	2160.1	4,350			
30	2161.1	3,828			
31	2162.1	4,010			
<u>Bartlesville Sand</u>					
32	2212.1	13,275			
33	2213.1	78,850			
34	2214.1	81,500			
35	2215.1	81,250			
36	2216.1	48,000			
37	2217.1	74,750			

Note: ppm — parts per million

Oilfield Research Laboratories
RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VI

Company Jackson Brothers Lease Jackson-Covert Well No. 4

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
		<u>Bartlesville Sand</u>			
38	2218.1	72,750			
39	2219.1	28,680			
40	2220.1	35,425			
41	2221.1	32,500			
42	2222.1	19,000			
43	2223.1	8,570			
44	2224.1	6,280			
45	2225.1	27,720			
46	2226.1	8,425			

Note: ppm — parts per million

Oilfield Research Laboratories
SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company	Jackson Brothers	Lease	Jackson-Covert	Well No.
Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water	
CATTLEMAN SAND				
2131.8 - 2136.6	4,936			
2136.6 - 2150.6	12,539			
2150.6 - 2162.7	6,383			
2131.8 - 2162.7	8,949			
BARTLESVILLE SAND				
2212.0 - 2227.2	40,573			

Note: ppm — parts per million.