



OILFIELD RESEARCH LABORATORIES

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

December 11, 1968

Robert K. Butcher
921 Unadila Street
Shreveport, Louisiana 71100

Dear Sir:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Ellis Lease, Well No. 77-W, Greenwood County, Kansas, and submitted to our laboratory on December 8, 1968.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:dp

1 c. - Shreveport, Louisiana
1 c. - Madison, Kansas
1 c. - Tulsa, Oklahoma

-2-

A fresh water mud was used as a circulating fluid in the coring of the sand in this well. The core was sampled and sealed in tin cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
1912.0 - 1914.4	Dark shale.
1914.4 - 1915.5	Light brown coarse grained slightly calcareous slightly conglomeratic carbonaceous sandstone.
1915.5 - 1916.0	Dark shale.
1916.0 - 1916.3	Light brown coarse grained slightly calcareous slightly conglomeratic carbonaceous sandstone containing a coal streak.
1916.3 - 1921.0	Light brown coarse grained slightly conglomeratic slightly calcareous sandstone.
1921.0 - 1931.0	Light brown coarse grained slightly calcareous sandstone.
1931.0 - 1931.9	Brown medium grained slightly calcareous slightly carbonaceous sandstone.
1931.9 - 1934.0	Dark shale.

Coring was started at a depth of 1912.0 feet in dark shale and completed at 1934.0 feet in same type of material. This core shows a total of 16.7 feet of sandstone. For the most part, the pay is made up of light brown coarse grained slightly calcareous and conglomeratic sandstone. Approximately three hours were required to cut the first core.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 92.4

and 128.5 millidarcys respectively; the overall average being 103.7 (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 33 to a maximum of 198 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 21.5. The weighted average percent oil saturation of the upper and lower sections is 20.4 and 23.9 respectively. The weighted average percent water saturation of the upper and lower sections is 54.8 and 64.6 respectively; the overall average being 57.8 (See Table III). This gives an overall weighted average total fluid saturation of 79.3 percent. This low total fluid saturation indicates considerable 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, nine 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 sand was badly flushed during the cutting of the core as the chloride content of the water in the core is much lower than the average for the sand in this area.

The weighted average oil content of the upper and lower sections is 310 and 345 barrels per acre foot respectively; the overall average being 321. The total oil content, as shown by this core, is 5,039 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Inasmuch as the sand in the core has a low oil saturation, one would

expect very little, if any, oil to be recovered by laboratory flooding tests.

A total recovery of 361 barrels of oil per acre was obtained from 9.2 feet of sand. The weighted average percent oil saturation was reduced from 21.4 to 18.9, or represents an average recovery of 2.5 percent. The weighted average effective permeability of the samples is 4.31 millidarcys, while the average initial fluid production pressure is 19.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 17 samples tested, all produced water and 10 oil. This indicates that approximately 59 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a rather wide variation in effective permeability.

CONCLUSION

On the basis of the above data, we estimate that approximately 3,590 barrels of oil per acre or an average of 251 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:

Original formation volume factor	1.17
Present formation volume factor	1.05
Irreducible water saturation, percent	40.0
Primary recovery, percent	None
Average porosity, percent	19.4
Oil saturation after flooding, percent	18.9
Performance factor, percent	50.0
Net floodable pay sand, feet	14.3

This core shows a rather clean sand section having a low oil saturation, a high water saturation, and a good porosity and permeability. The long exposure of the core to the drilling fluid probably accounted for part of the low oil and high water saturations.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Robert K. Butcher Lease Ellis Well No. 77-W

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	1914.5	17.8	26	49	359	32	1.1	1.1	395	35.20
2	1916.5	21.6	25	44	419	48	0.7	1.8	293	33.60
3	1917.4	16.7	21	62	272	-	0.5	2.3	136	-
P-3	1917.6	-	-	-	-	95	0.5	2.8	-	47.50
4	1918.5	18.1	18	59	253	143	1.0	3.8	253	143.00
5	1919.5	20.9	18	47	292	135	1.0	4.8	292	135.00
6	1920.5	19.7	20	55	306	163	1.0	5.8	306	163.00
7	1921.5	20.4	19	59	301	107	1.0	6.8	301	107.00
8	1922.4	18.0	27	58	377	-	0.5	7.3	188	-
P-8	1922.6	-	-	-	-	156	0.5	7.8	-	78.00
9	1923.5	21.0	19	58	310	122	1.0	8.8	310	122.00
10	1924.5	19.3	17	52	255	61	1.0	9.8	255	61.00
11	1925.5	20.8	19	59	307	40	1.0	10.8	307	40.00
12	1926.5	20.2	20	58	314	33	1.0	11.8	314	33.00
13	1927.5	18.9	22	67	323	133	1.0	12.8	323	133.00
14	1928.5	19.6	25	65	380	198	1.0	13.8	380	198.00
15	1929.5	18.7	22	63	319	126	1.0	14.8	319	126.00
16	1930.5	19.6	19	65	289	90	1.0	15.8	289	90.00
17	1931.5	16.9	32	63	420	92	0.9	16.7	378	82.80

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Lease	Well No.
Robert K. Butcher	Ellis	77-W

Depth Interval, Feet	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
1914.4 - 1927.0	10.8	92.4	998.30	
1927.0 - 1931.9	4.9	128.5	629.80	
1914.4 - 1931.9	15.7	103.7	1,628.10	

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
1914.4 - 1927.0	10.8	19.7	20.4	54.8	310	3,350
1927.0 - 1931.9	4.9	18.8	23.9	64.6	345	1,689
1914.4 - 1931.9	15.7	19.4	21.5	57.8	321	5,039

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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	1914.5	17.3	28	376	0	0	28	376	10	0.30	30
2	1916.5	21.6	25	419	4	67	21	352	102	2.10	15
3	1917.4	17.0	23	303	0	0	23	303	33	0.70	25
4	1918.5	18.5	19	273	0	0	19	273	79	2.40	15
5	1919.5	20.6	18	288	1	16	17	272	160	5.20	15
6	1920.5	20.0	20	311	1	16	19	295	51	1.30	25
7	1921.5	20.3	19	315	2	31	18	284	111	3.70	15
8	1922.4	18.5	27	388	5	72	22	316	16	0.37	30
9	1923.5	21.3	21	347	0	0	21	347	51	1.50	25
10	1924.5	19.8	17	261	0	0	17	261	188	5.40	15
11	1925.5	20.4	19	301	2	32	17	269	109	3.40	15
12	1926.5	19.9	20	308	1	15	19	293	41	1.10	25
13	1927.5	19.4	22	331	2	30	20	301	90	2.10	25
14	1928.5	20.0	25	388	7	109	18	279	207	19.84	5
15	1929.5	19.0	22	324	2	29	20	295	34	1.40	25
16	1930.5	20.0	18	279	0	0	18	279	172	5.00	15
17	1931.5	17.3	32	430	0	0	32	430	64	1.66	25

Company Robert K. Butcher Lease Ellis Well No. 77-W

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	Lease	Well No.	77-W
Robert K. Butcher	Ellis		
Depth Interval, Feet	1914.4 - 1927.0	1927.0 - 1931.9	1914.4 - 1931.9
Feet of Core Analyzed	6.2	3.0	9.2
Average Percent Porosity	20.2	19.5	20.0
Average Percent Original Oil Saturation	20.7	23.0	21.4
Average Percent Oil Recovery	2.0	3.7	2.5
Average Percent Residual Oil Saturation	18.7	19.3	18.9
Average Percent Residual Water Saturation	70.1	73.4	71.2
Average Percent Total Residual Fluid Saturation	88.8	92.7	90.1
Average Original Oil Content, Bbls./A. Ft.	324.	348.	332.
Average Oil Recovery, Bbls./A. Ft.	31.	56.	39.
Average Residual Oil Content, Bbls./A. Ft.	293.	292.	293.
Total Original Oil Content, Bbls./Acre	2,011.	1,043.	3,054.
Total Oil Recovery, Bbls./Acre	193.	168.	361.
Total Residual Oil Content, Bbls./Acre	1,818.	875.	2,693.
Average Effective Permeability, Millidarcys	2.64	7.78	4.31
Average Initial Fluid Production Pressure, p.s.i.	19.6	18.3	19.2

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 Robert K. Butcher Lease Ellis Well No. 77-W

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate Drilling & Foreign	Total
1	1914.5	19,900		
3	1917.4	9,250		
5	1919.5	7,710		
7	1921.5	7,540		
9	1923.5	8,730		
11	1925.5	6,135		
13	1927.5	7,280		
15	1929.5	5,220		
17	1931.5	43,000		
Average chloride content - 13,193 parts per million				

Note: ppm — parts per million