● CORE ANALYSIS ● WATER REPRESSURING ENGINEERING ● WATER ANALYSIS ● FLOODING WATER TREATMENT ● SURVEYING

OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

700 NORTH MISSION
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Chanute, Kansas

536 N. HIGHLAND
CHANUTE, KANSAS
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August 30, 1961

Gordon Willis
319 West 7th
Chanute, Kansas

Dear Sir:

Enclosed herewith is the report of the analysis of the Cable tool core taken from the Ralph Evans Lease, Well No. 3, Allen County, Kansas, and submitted to our laboratory on August 19, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Fred O. Stenger

Fred O. Stenger

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FIRST SAND

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GENERAL INFORMATION & SUMMARY

Company Gordon Willis Lease Ralph Evans Well No. 3

Location W½

Section 12 Twp. 25S Rge. 19E County Allen State Kansas

Name of Sand	Bartlesville
Top of Core	736.5
Bottom of Core	750.2
Top of Sand (Good)	738.4
Bottom of Sand	748.6
Total Feet of Permeable Sand	7.2
Total Feet of Floodable Sand	-

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 20	0.6	0.6
20 - 30	4.5	5.1
30 & above	2.1	7.2

Average Permeability Millidarcys	31.
Average Percent Porosity	18.6
Average Percent Oil Saturation	37.8
Average Percent Water Saturation	47.8
Average Oil Content, Bbls./A. Ft.	545.
Total Oil Content, Bbls./Acre	4,460.
Average Percent Oil Recovery by Laboratory Flooding Tests	-
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	-
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	-
Total Calculated Primary Oil Recovery, Bbls./Acre	1,100.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

SECOND SAND

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Gordon Willis Lease Ralph Evans Well No. 3

Location W½

Section 12 Twp. 25S Rge. 19E County Allen State Kansas

Name of Sand	Bartlesville
Top of Core	764.5
Bottom of Core	784.2
Top of Sand	764.5
Bottom of Sand	779.2
Total Feet of Permeable Sand (Analyzed)	7.7
Total Feet of Floodable Sand	-

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 20	2.7	2.7
20 - 40	4.0	6.7
40 & above	1.0	7.7

Average Permeability Millidarcys	29.
Average Percent Porosity	18.8
Average Percent Oil Saturation	44.5
Average Percent Water Saturation	46.3
Average Oil Content, Bbls./A. Ft.	651.
Total Oil Content, Bbls./Acre	9,567.
Average Percent Oil Recovery by Laboratory Flooding Tests	-
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	-
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	-
Total Calculated Primary Oil Recovery, Bbls./Acre	2,030.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

THIRD SAND

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Gordon Willis Lease Ralph Evans Well No. 3

Location W½

Section 12 Twp. 25S Rge. 19E County Allen State Kansas

Name of Sand	Bartlesville
Top of Core	829.0
Bottom of Core	857.9
Top of Pay Sand	842.5
Bottom of Pay Sand	852.5
Total Feet of Permeable Sand	12.0
Total Feet of Floodable Sand	4.7

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 60	2.7	2.7
60 - 100	4.5	7.2
100 & above	4.8	12.0

Average Permeability Millidarcys	126.
Average Percent Porosity	20.4
Average Percent Oil Saturation	52.0
Average Percent Water Saturation	31.4
Average Oil Content, Bbls./A. Ft.	849.
Total Oil Content, Bbls./Acre	10,213.
Average Percent Oil Recovery by Laboratory Flooding Tests	9.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	157.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	739.
Total Calculated Oil Recovery, Bbls./Acre	904.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Water was used as the circulating fluid in the coring of the sand in this well. This well was drilled in a virgin area. Three different sands were cored. A 15.9 foot layer of black shale and coal separated the first two sands and a 44.8 foot layer, presumed to be shale and/or sandy shale, separated the second and third sands.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
736.5 - 738.4	Sandy shale.
738.4 - 739.4	Laminated sandstone and shale.
739.4 - 744.0	Brown slightly laminated slightly shaley sandstone.
744.0 - 746.0	Sandy shale.
746.0 - 747.0	Laminated sandstone and shale.
747.0 - 748.6	Hard dark brown calcareous sandstone.
748.6 - 750.2	Black shale and coal.
750.2 - 764.5	Shale.
764.5 - 772.2	Brown slightly laminated slightly shaley sandstone.
772.2 - 779.2	Brown finely laminated shaley sandstone.
779.2 - 784.2	Shale.
784.2 - 829.0	Drilled.
829.0 - 841.0	Sandy shale.
841.0 - 844.2	Dark brown sandstone.
844.2 - 848.5	Sandy shale.
848.5 - 852.5	Dark brown sandstone.
852.5 - 857.3	Dark brown laminated shaley carbonaceous sandstone.
857.3 - 857.9	Carbonaceous sandy shale.

Coring was started at a depth of 736.5 feet in sandy shale and completed at 857.9 feet in carbonaceous sandy shale. This core shows a total of 34.9 feet of sandstone, a part of which contained laminated

layers of shale. For the most part, the pay is made up of shaley or finely laminated shaley sandstone with some dark brown sandstone in the third or lower sand.

PERMEABILITY

For the sake of distribution, the core was divided into three sections separating each of the three sands. The weighted average permeability of the upper, middle and lower sections is 31, 29 and 126 millidarcys respectively; the overall average being 73 (See Table III). By observing the data given on the coregraph, it is noticeable that the three sands each have a fairly uniform permeability. The permeability of the three sands varies from impermeable to a maximum of 276. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 45.5. The weighted average percent oil saturation of the upper, middle and lower sections is 37.8, 44.5 and 52.0 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 47.8, 46.3 and 31.4 respectively; the overall average being 41.3 (See Table III). This gives an overall weighted average total fluid saturation of 86.8 percent. This low total fluid saturation indicates considerable fluid was lost during coring which was probably oil.

The weighted average oil content of the upper, middle and lower sections is 545, 651, and 849 barrels per acre foot respectively; the overall average being 694. The total oil content, as shown by this core, is 24,240 barrels per acre of which 10,213 barrels are in the third sand section (See Table III).

LABORATORY FLOODING TESTS

Only the lower or third sand in this core was tested for water flooding. This third sand responded fairly well to laboratory flooding

tests, as a total recovery of 157 barrels of oil per acre was obtained from 4.7 feet of sand. The weighted average percent oil saturation was reduced from 51.3 to 41.5, or represents an average recovery of 9.8 percent. The weighted average effective permeability of the samples is 8.32 millidarcys, while the average initial fluid production pressure is 27.7 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 12 samples tested, 11 produced water and 5 oil. This indicates that approximately 39 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a fairly good effective permeability.

CONCLUSION

On the basis of the above data and assuming that all three of the sands are virgin sands, it is believed that the first sand should produce, by efficient primary methods, approximately 138 barrels per acre foot or 1,100 barrels per acre for the 8.0 feet of sand analyzed. Similarly the second sand should produce 138 barrels per acre foot or 2,030 barrels for the 14.7 feet of sand analyzed and the third sand should produce 106 barrels per acre foot or 760 barrels per acre from 7.2 feet of pay sand analyzed.

It is further believed that an efficient water-flood on the third sand, in the vicinity of this well, will recover approximately 960 barrels of oil per acre or an average of 204 barrels per acre foot from the 4.7 feet of floodable pay sand analyzed.

In calculating this recovery the following factors and assumptions were used:

Original formation volume factor	1.05
Present formation volume factor	1.02
True water saturation, percent	26.0

Primary oil recovery	7.0
Calculated present oil saturation, percent	64.4
Porosity, percent	20.3
Oil saturation at abandonment, percent	41.5
Performance factor, percent	55.0

This core contains some carbonaceous shaley sandstone in the third or lower sand which reduces considerably the footage of effective pay sand.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Gordon Willis Lease Ralph Evans Well No. 3

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.		
						FIRST SAND					
1	739.3	11.9	24	66	90	222	23.	1.0	1.0	222	23.00
2	740.1	20.3	36	50	86	567	38.	1.1	2.1	567	41.80
3	741.1	20.3	40	43	83	630	29.	1.0	3.1	630	29.00
4	742.1	21.7	37	47	84	623	24.	1.2	4.3	748	28.80
5	743.1	21.6	38	43	81	636	24.	1.3	5.6	826	31.20
6	746.1	15.9	30	60	90	371	Imp.	1.0	6.6	371	0.00
7	747.1	19.3	46	43	89	689	19.	0.6	7.2	413	11.40
8	748.1	16.0	55	29	84	683	55.	1.0	8.2	683	55.00
						SECOND SAND					
9	765.1	18.0	47	44	91	656	12.	1.0	9.2	656	12.00
10	766.1	21.1	48	44	92	786	61.	1.0	10.2	786	61.00
11	767.1	19.0	48	43	91	708	27.	1.0	11.2	708	27.00
12	768.1	18.7	40	43	83	580	30.	1.0	12.2	580	30.00
13	769.1	19.1	45	46	91	666	36.	1.0	13.2	666	36.00
14	770.1	18.0	42	50	92	586	28.	1.0	14.2	586	28.00
15	771.1	19.3	44	47	91	659	19.	1.0	15.2	659	19.00
16	772.1	21.0	46	45	91	750	18.	0.7	15.9	524	12.60
17	773.1	17.5	35	56	91	475	-	1.3	17.2	618	-
18	774.1	18.6	46	47	93	664	-	1.0	18.2	664	-
19	775.1	20.0	47	43	90	730	-	1.0	19.2	730	-
20	776.1	19.2	39	53	92	581	-	1.0	20.2	581	-
21	777.1	19.3	57	35	92	854	-	1.0	21.2	854	-
22	778.1	16.8	50	42	92	651	-	1.0	22.2	651	-
23	779.1	16.0	35	57	92	435	-	0.7	22.9	304	-

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Gordon Willis Lease Ralph Evans Well No. 3

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.		
						THIRD SAND					
24	841.1	22.0	50	30	80	854	82.	0.5	23.4	427	41.00
25	842.1	19.6	50	28	78	761	82.	1.0	24.4	761	82.00
26	843.1	19.7	50	35	85	765	216.	1.0	25.4	765	216.00
27	844.1	17.9	42	24	66	584	52.	0.7	26.1	408	36.40
28	849.1	19.8	42	37	79	645	67.	1.0	27.1	645	67.00
29	850.1	19.8	53	30	83	814	52.	1.0	28.1	814	52.00
30	851.1	21.8	60	27	87	1,017	252.	1.0	29.1	1,017	252.00
31	852.1	21.4	60	28	88	996	101.	1.0	30.1	996	101.00
32	853.1	22.1	47	34	81	806	87.	1.0	31.1	806	87.00
33	854.1	11.9	27	66	93	250	89.	1.0	32.1	250	89.00
34	855.1	22.9	60	29	89	1,069	40.	1.0	33.1	1,069	40.00
35	856.1	25.2	72	21	93	1,408	276.	1.0	34.1	1,408	276.00
36	857.1	21.6	63	13	76	1,059	216.	0.8	34.9	847	172.50

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III - B

Company Gordon Willis Lease Ralph Evans Well No. 3

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
		FIRST SAND	
738.4 - 748.6	7.2	31.	220.20
		SECOND SAND	
764.5 - 772.2	7.7	29.	225.60
		THIRD SAND	
841.0 - 857.3	12.0	126.	1511.90

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
			FIRST SAND			
738.4 - 748.6	8.2	18.6	37.8	47.8	545	4,460
			SECOND SAND			
764.5 - 779.2	14.7	18.8	44.5	46.3	651	9,567
			THIRD SAND			
841.0 - 857.3	12.0	20.4	52.0	31.4	849	10,213

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

THIRD SAND

Company Gordon Willis Lease Ralph Evans Well No. 3

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.			
24	841.1	22.0	50	854	0	0	50	30	854	20	0.622	40
25	842.1	19.6	50	761	0	0	50	28	761	24	0.960	40
26	843.1	19.8	50	768	16	246	34	59	522	183	8.16	30
27	844.1	18.0	42	586	3	42	39	52	544	162	7.62	20
28	849.1	19.9	42	648	4	62	38	57	586	243	13.25	20
30	851.1	21.9	60	1020	10	170	50	48	850	139	7.05	30
31	852.1	21.5	60	1000	14	232	46	51	768	100	3.00	30
32	853.1	22.0	47	802	0	0	47	34	802	24	0.890	30
33	854.1	12.0	27	251	0	0	27	66	251	25	1.16	30
34	855.1	22.8	60	1060	0	0	60	29	1060	10	0.292	50
35	856.1	25.1	72	1400	0	0	72	21	1400	0	Imp.	50+
36	857.1	21.5	63	1050	0	0	63	13	1050	15	1.12	50

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

THIRD SAND

Company Gordon Willis Lease Ralph Evans Well No. 3

Depth Interval, Feet	842.5 - 852.5
Feet of Core Analyzed	4.7
Average Percent Porosity	20.3
Average Percent Original Oil Saturation	51.3
Average Percent Oil Recovery	9.8
Average Percent Residual Oil Saturation	41.5
Average Percent Residual Water Saturation	53.5
Average Percent Total Residual Fluid Saturation	95.0
Average Original Oil Content, Bbls./A. Ft.	817.
Average Oil Recovery, Bbls./A. Ft.	157.
Average Residual Oil Content, Bbls./A. Ft.	660.
Total Original Oil Content, Bbls./Acre	3,846.
Total Oil Recovery, Bbls./Acre	739.
Total Residual Oil Content, Bbls./Acre	3,107.
Average Effective Permeability, Millidarcys	8.32
Average Initial Fluid Production Pressure, p.s.i.	27.7

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