WALTER D. WELLS, JR.

CORE ANALYSIS REPORT

FRED McGOWEN LEASE WELL NO. CT-A

NEOSHO COUNTY, KANSAS

OILFIELD RESEARCH LABORATORIES
538 N. HIGHLAND CHANUTE, KANSAS

OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

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536 N. HIGHLAND
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September 23, 1963

Walter D. Wells, Jr.
804 South Coast Building
Houston 2, Texas

Dear Sir:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Fred McGowen Lease, Well No. CT-A, Neosho County, Kansas, and submitted to our laboratory on September 14, 1963.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:rf

3 c. - Houston, Texas
3 c. - Dallas, Texas

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Walter D. Well, Jr. Lease Fred McGowen Well No. CT-A

Location SE SW

Section 15 Twp. 28S Rge. 19E County Neosho State Kansas

Name of Sand	Upper Bartlesville
Top of Core	594.0
Bottom of Core	611.0
Top of Oil Sand	601.4
Bottom of Sand	610.0
Total Feet of Permeable Sand	10.1
Total Feet of Floodable Sand	6.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	2.0	2.0
10 - 20	4.0	6.0
20 - 30	1.7	7.7
30 & above	2.4	10.1

Average Permeability Millidarcys	20.9
Average Percent Porosity	18.1
Average Percent Oil Saturation	36.0
Average Percent Water Saturation	46.2
Average Oil Content, Bbls./A. Ft.	518.
Total Oil Content, Bbls./Acre	5,545.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.7
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	94.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	375.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	1,476.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

Location SE SW

Section 15 Twp. 28S Rge. 19E County Neosho State Kansas

Name of Sand	Lower Bartlesville
Top of Core	639.0
Bottom of Core	671.0
Top of Sand (Received)	639.0
Bottom of Sand	668.0
Total Feet of Permeable Sand	28.0
Total Feet of Floodable Sand	10.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	12.0	12.0
5 - 10	3.0	15.0
10 - 20	5.0	20.0
20 - 30	5.0	25.0
30 & above	3.0	28.0

Average Permeability Millidarcys	14.4
Average Percent Porosity	17.9
Average Percent Oil Saturation	47.4
Average Percent Water Saturation	40.8
Average Oil Content, Bbls./A. Ft.	651.
Total Oil Content, Bbls./Acre	18,223.
Average Percent Oil Recovery by Laboratory Flooding Tests	12.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	185.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	2,411.
Total Calculated Oil Recovery, Bbls./Acre	1,910.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Water was used as a circulating fluid in the coring of the sand in this well. The cores were sealed in plastic bags and submitted to us by the client.

UPPER BARTLESVILLE SAND

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
594.0 - 598.0	Shale.
598.0 - 599.3	Light brown and gray, shaly sandstone.
599.3 - 610.0	Brown, fine grained, shaly sandstone.
610.0 - 611.0	Shale.

Coring was started at a depth of 594.0 feet in shale and completed at 611.0 feet in the same type of material. This core shows a total of 10.7 feet of sandstone. For the most part, the pay is made up of brown, fine grained, shaly sandstone.

PERMEABILITY

The weighted average permeability of the cored section is 20.9 millidarcys (See Table III). By observing the data given on the core-graph, it is noticeable that the sand has a rather wide variation in permeability. The permeability of the sand varies from 3.0 to a maximum of 37. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fair weighted average percent oil saturation, namely, 36.0. The weighted average percent water saturation of the cored section is 46.2 (See Table III). This gives an overall weighted average total fluid saturation of 82.2 percent.

The weighted average oil content of the cored section is 518 barrels per acre; while the total oil content, as shown by this core, is 5,545 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Part of the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 375 barrels of oil per acre was obtained from 4.0 feet of sand. The weighted average percent oil saturation was reduced from 41.2 to 34.5, or represents an average recovery of 6.7 percent. The weighted average effective permeability of the samples is 0.35 millidarcys, while the average initial fluid production pressure is 50.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 11 samples tested, 9 produced water and 4 oil. This indicates that approximately 36 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand samples, after flooding, had a rather high residual oil saturation.

CONCLUSION

On the basis of the above data, it is evident that approximately 576 barrels of oil per acre can be recovered from the area, represented by this core, by efficient primary production methods. An additional oil recovery of 900 barrels per acre can be expected by efficient waterflooding provided the sand will take an ample volume of water satisfactorily. The following data was used in calculating the above oil recovery values:

Original formation volume factor	1.05
Present formation volume factor	1.05
Irreducible water saturation, percent	35.0
Primary recovery, estimated, percent	None.
Present oil saturation, percent	63.1
Average porosity, percent	18.2
Oil saturation after flooding, percent	34.5

Performance factor, percent	50.0
Net floodable pay sand, feet	6.0

This core shows a thin shaly sand section having fair oil saturation, a rather high water saturation and a low effective permeability.

LOWER BARTLESVILLE SAND

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
639.0 - 659.0	Brown, fine grained, shaly sandstone.
659.0 - 660.0	Shale.
660.0 - 668.0	Brown to dark, slightly carbonaceous, shaly sandstone.
668.0 - 671.0	Shale.

Coring was started at a depth of 639.0 feet in brown, fine grained, shaly sandstone and completed at 671.0 feet in shale. This core shows a total of 28.0 feet of sandstone. For the most part, the pay is made up of brown, fine grained, shaly 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 7.9, 3.9 and 34.1 millidarcys respectively; the overall average being 14.4 (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 0.05 to a maximum of 85. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 47.4. The weighted average percent oil saturation of the upper, middle and lower sections is 55.2, 50.3 and 37.9 respect-

ively. The weighted average percent water saturation of the upper, middle and lower sections is 33.2, 40.4 and 46.2 respectively; the overall average being 40.8 (See Table III). This gives an overall weighted average total fluid saturation of 88.2 percent.

The weighted average oil content of the upper, middle and lower sections is 768, 656 and 565 barrels per acre foot respectively; the overall average being 651. The total oil content, as shown by this core, is 18,233 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Part of the sand in this core responded rather well to laboratory flooding tests, as a total recovery of 2,411 barrels of oil per acre was obtained from 13.0 feet of sand. The weighted average percent oil saturation was reduced from 44.8 to 32.0, or represents an average recovery of 12.8 percent. The weighted average effective permeability of the samples is 1.45 millidarcys, while the average initial fluid production pressure is 33.9 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 28 samples tested, 13 produced water and oil. This indicates that approximately 46 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand, for the most part, is very tight.

CONCLUSION

From a study of the above data, it is evident that a recovery of approximately 1,910 barrels of oil per acre or an average of 191 barrels per acre can be expected from the area, represented by this core, by efficient water-flooding provided the sand will take an ample volume of water satisfactorily. The following data was used in calculating the above oil recovery value:

Original formation volume factor	1.05
Present formation volume factor	1.02
Irreducible water saturation, percent	35.0
Primary recovery, estimated, percent	7.0
Present oil saturation, percent	56.1
Average porosity, percent	18.9
Oil saturation after flooding, percent	32.0
Performance factor, percent	55.0
Net floodable pay sand, feet	10.0

This core shows a shaly sand section having a good oil saturation, a fair water saturation and a low average permeability. From the data given in Table 4 and on the coregraph it is noticeable that the pay sand is located at the top and bottom parts of the sand section.

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

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.		
						UPPER BARTLESVILLE					
1	599.5	17.2	21	59	80	280	23.	0.7	0.7	196	16.10
2	600.5	19.0	25	59	84	368	18.	1.0	1.7	368	18.00
F-3	601.3	15.7	19	-	-	232	-	0.6	2.3	139	-
3	601.5	19.0	45	53	98	663	36.	0.4	2.7	265	14.40
4	602.5	16.2	39	51	90	490	16.	1.0	3.7	490	16.00
5	603.5	20.2	33	49	82	518	19.	1.0	4.7	518	19.00
6	604.5	16.0	35	59	94	434	37.	1.0	5.7	434	37.00
7	605.5	20.0	31	45	76	481	36.	1.0	6.7	481	36.00
8	606.5	19.7	40	39	79	611	28.	1.0	7.7	611	28.00
9	607.5	17.6	52	31	83	709	3.0	1.0	8.7	709	3.00
10	608.5	18.9	45	38	83	659	5.1	1.0	9.7	659	5.10
11	609.5	17.1	51	33	84	675	19.	1.0	10.7	675	19.00
						LOWER BARTLESVILLE					
12	639.5	18.8	48	31	79	699	9.9	1.0	11.7	699	9.90
13	640.5	17.9	51	38	89	709	5.0	1.0	12.7	709	5.00
14	641.5	16.7	65	30	95	840	4.1	1.0	13.7	840	4.10
15	642.5	17.3	63	30	93	844	10.	1.0	14.7	844	10.00
16	643.5	17.8	49	36	85	676	6.1	1.0	15.7	676	6.10
17	644.5	19.7	55	34	89	839	12.	1.0	16.7	839	12.00
18	645.5	20.1	48	32	80	747	0.05	1.0	17.7	747	0.05
19	646.5	14.9	47	45	92	542	2.4	1.0	18.7	542	2.40
20	647.5	15.4	57	38	95	680	1.5	1.0	19.7	680	1.50
21	648.5	13.6	39	47	86	411	1.7	1.0	20.7	411	1.70
22	649.5	16.6	57	39	96	734	2.9	1.0	21.7	734	2.90

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

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.		
23	650.5	17.8	52	45	97	718	3.6	1.0	22.7	718	3.60
24	651.5	16.7	54	44	98	699	2.4	1.0	23.7	699	2.40
25	652.5	20.7	57	28	85	915	4.6	1.0	24.7	915	4.60
26	653.5	17.9	51	31	82	708	3.2	1.0	25.7	708	3.20
27	654.5	16.4	52	44	96	661	13.	1.0	26.7	661	13.00
28	655.5	18.9	43	37	80	630	13.	1.0	27.7	630	13.00
29	656.5	14.9	50	46	96	576	1.3	1.0	28.7	576	1.30
30	657.5	14.1	47	50	97	514	0.88	1.0	29.7	514	0.88
31	658.5	20.6	54	42	96	864	33.	1.0	30.7	864	33.00
32	660.5	19.8	42	41	83	645	26.	1.0	31.7	645	26.00
33	661.5	15.6	45	46	91	544	19.	1.0	32.7	544	19.00
34	662.5	16.9	45	42	87	589	24.	1.0	33.7	589	24.00
35	663.5	17.0	36	47	83	474	25.	1.0	34.7	474	25.00
36	664.5	20.4	37	42	79	584	20.	1.0	35.7	584	20.00
37	665.5	21.4	30	53	83	498	85.	1.0	36.7	498	85.00
38	666.5	21.0	26	51	77	424	26.	1.0	37.7	424	26.00
39	667.5	22.8	26	52	78	459	49.	1.0	38.7	459	49.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
	UPPER BARTLESVILLE SAND		
599.3 - 610.0	10.1	20.9	211.60
	LOWER BARTLESVILLE SAND		
639.0 - 645.0	6.0	7.9	47.10
645.0 - 658.0	13.0	3.9	50.53
658.0 - 668.0	9.0	34.1	307.00
639.0 - 668.0	28.0	14.4	404.63

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
			UPPER BARTLESVILLE SAND			
599.3 - 610.0	10.7	18.1	36.0	46.2	518	5,545
			LOWER BARTLESVILLE SAND			
639.0 - 645.0	6.0	18.0	55.2	33.2	768	4,607
645.0 - 658.0	13.0	16.8	50.3	40.4	656	8,535
658.0 - 668.0	9.0	19.5	37.9	46.2	565	5,081
639.0 - 645.0	28.0	17.9	47.4	40.8	651	18,223

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

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.			
					UPPER BARTLESVILLE SAND							
1	599.5	17.8	19	262	0	0	19	73	262	189	3.40	10
2	600.5	18.5	27	388	0	0	27	63	388	2	0.100	50
3	601.3	15.7	19	232	0	0	19	62	232	4	0.100	50
4	602.5	15.8	34	417	0	0	34	60	417	0	Imp.	-
5	603.5	19.9	33	510	4	62	29	60	448	32	0.800	50
6	604.5	16.5	35	448	5	64	30	67	384	7	0.200	50
7	605.5	20.6	31	495	0	0	31	67	495	148	3.10	20
8	606.5	19.3	40	599	0	0	40	52	599	10	0.400	50
9	607.5	17.1	52	690	12	159	40	45	531	4	0.200	50
10	608.5	19.3	45	674	6	90	39	47	584	5	0.200	50
					LOWER BARTLESVILLE SAND							
11	609.5	16.7	46	596	0	0	46	42	596	0	Imp.	-
12	639.5	18.2	48	678	13	184	35	55	494	5	0.200	30
13	640.5	17.4	51	689	8	108	43	50	581	0	0.005	50
14	641.5	17.1	65	862	23	305	42	55	557	1	0.100	30
15	642.5	16.7	57	739	0	0	57	40	739	0	Imp.	-
16	643.5	18.2	49	693	20	283	29	61	410	5	0.200	30
17	644.5	19.2	55	820	22	328	33	57	492	2	0.200	30
18	645.5	19.5	44	666	0	0	44	38	666	0	Imp.	-
19	646.5	15.1	42	492	0	0	42	53	492	0	Imp.	-
20	647.5	15.0	51	594	0	0	51	47	594	0	Imp.	-
21	648.5	14.0	35	380	0	0	35	55	380	0	Imp.	-
22	649.5	16.1	52	650	0	0	52	45	650	0	Imp.	-
23	650.5	17.4	46	622	0	0	46	52	622	0	Imp.	-
24	651.5	17.0	50	660	0	0	50	49	660	0	Imp.	-

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

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

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.			
25	652.5	20.0	55	854	0	0	55	32	854	0	Imp.	-
26	653.5	18.2	46	650	0	0	46	39	650	0	Imp.	-
27	654.5	16.0	47	584	0	0	47	51	584	0	Imp.	-
28	655.5	18.4	40	572	0	0	40	43	572	0	Imp.	-
29	656.5	15.3	45	534	0	0	45	53	534	0	Imp.	-
30	657.5	14.6	43	487	0	0	43	56	487	0	Imp.	-
31	658.5	20.3	54	850	26	409	28	70	441	44	0.900	30
32	660.5	19.7	42	642	14	214	28	64	428	47	1.40	40
33	661.5	16.2	45	555	11	138	34	60	417	10	0.300	50
34	662.5	17.4	45	607	12	162	33	57	445	21	0.500	40
35	663.5	17.4	36	486	5	67	31	61	419	35	0.900	40
36	664.5	20.6	37	591	8	128	29	54	463	23	0.500	40
37	665.5	22.0	30	512	4	68	26	67	444	209	12.00	10
38	666.5	21.4	28	465	0	0	28	67	465	55	1.70	10
39	667.5	22.4	26	452	1	17	25	68	435	55	1.70	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 Walter D. Wells, Jr. Lease Fred McGowen Well No. CT-A

Depth Interval, Feet	Upper B'ville 603.0 - 609.0	Lower Bartlesville 639.0 - 645.0	658.0 - 668.0	639.0 - 668.0
Feet of Core Analyzed	4.0	5.0	8.0	13.0
Average Percent Porosity	18.2	18.0	19.5	18.9
Average Percent Original Oil Saturation	41.2	53.6	39.4	44.8
Average Percent Oil Recovery	6.7	17.2	10.1	12.8
Average Percent Residual Oil Saturation	34.5	36.4	29.3	32.0
Average Percent Residual Water Saturation	54.8	55.6	62.6	60.0
Average Percent Total Residual Fluid Saturation	89.3	92.0	91.9	92.0
Average Original Oil Content, Bbls./A. Ft.	581.	749.	587.	549.
Average Oil Recovery, Bbls./A. Ft.	94.	242.	150.	185.
Average Residual Oil Content, Bbls./A. Ft.	487.	507.	437.	464.
Total Original Oil Content, Bbls./Acre	2,322.	3,742.	4,695.	8,437.
Total Oil Recovery, Bbls./Acre	375.	1,208.	1,203.	2,411.
Total Residual Oil Content, Bbls./Acre	1,947.	2,534.	3,492.	5,026.
Average Effective Permeability, Millidarcys	0.35	0.14	2.27	1.45
Average Initial Fluid Production Pressure, p.s.i.	50.0	34.0	33.8	33.9

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