OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

813 EAST SIXTH
OKMULGEE, OKLAHOMA
PHONE: 4444

Chanute, Kansas

536 N. HIGHLAND
CHANUTE, KANSAS
PHONE: 726

March 21, 1961

Burk Royalty Company
800 Oil & Gas Building
Wichita Falls, Texas

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Cox Lease, Well No. WS-1, Neosho County, Kansas, and submitted to our laboratory on March 12, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:db

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GENERAL INFORMATION & SUMMARY

Company Burk Royalty Company Lease Cox Well No. WS-1

Location SE¼

Section 18 Twp. 30S Rge. 18E County Neosho State Kansas

Name of Sand	Bartlesville
Top of Core	853.0
Bottom of Core	869.0
Top of Sand (According to field log)	850.0
Bottom of Sand	868.4
Total Feet of Permeable Sand (Analyzed)	13.6
Total Feet of Floodable Sand (Analyzed)	2.6

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	6.4	6.4
5 - 10	5.6	12.0
10 & above	1.6	13.6

Average Permeability Millidarcys	7.0
Average Percent Porosity	17.9
Average Percent Oil Saturation	48.9
Average Percent Water Saturation	36.6
Average Oil Content, Bbls./A. Ft.	700.
Total Oil Content, Bbls./Acre	10,499.
Average Percent Oil Recovery by Laboratory Flooding Tests	17.6
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	251.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	752.
Total Calculated Oil Recovery, Bbls./Acre	416.
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 sand in this well. This core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
853.0 - 854.0	Brown micaceous sandstone.
854.0 - 857.0	Dark brown sandstone.
857.0 - 862.2	Dark brown micaceous slightly shaley sandstone.
862.2 - 868.4	Dark carbonaceous slightly calcareous slightly shaley sandstone.
868.4 - 868.6	Shale.
868.6 - 869.0	Sandy conglomerate.

Coring was started at a depth of 853.0 feet in brown fine grained micaceous sandstone and completed at 869.0 feet in sandy conglomerate. This core shows a total of 15.0 feet of sandstone. According to the field log, 3 feet of sand was drilled before coring was started. For the most part, the pay is made up of dark brown sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 14.2 and 4.0 millidarcys respectively; the overall average being 7.0 (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 Impermeable to a maximum of 52 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a very good weighted average percent oil

saturation, namely, 48.8. The weighted average percent oil saturation of the upper and lower sections is 48.3 and 49.0 respectively. The weighted average percent water saturation of the upper and lower sections is 34.5 and 37.4 respectively; the overall average being 36.6 (See Table III). This gives an overall weighted average total fluid saturation of 85.4 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 and lower sections is 757 and 679 barrels per acre foot respectively; the overall average being 700. The total oil content, as shown by this core, is 10,499 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Some of the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 752 barrels of oil per acre was obtained from 3.0 feet of sand. The weighted average percent oil saturation was reduced from 56.6 to 39.0, or represents an average recovery of 17.6 percent. The weighted average effective permeability of the samples is 1.66 millidarcys, while the average initial fluid production pressure is 39.3 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 15 samples tested, 3 produced water and oil. This indicates that approximately 20 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.

CONCLUSION

On the basis of the above data, it is evident that an efficient waterflood, within the vicinity of this well, will recover approximately 416 barrels of oil per acre or an average of 166 barrels per acre foot from

the 2.6 feet of floodable pay sand analyzed. The following factors and assumptions were used in calculating the above oil recovery value:

Original formation volume factor	1.06
Present formation volume factor	1.02
Irreducible water saturation, percent	31.0
Primary oil recovery, percent	4.0
Present oil saturation, percent	62.4
Oil saturation after flooding, percent	39.0
Percent porosity	18.6
Performance factor	0.50

This core shows a fairly clean sand section having a good oil saturation, a fair water saturation and a low permeability. Only that part of the sand section extending from 853 to 857 feet was permeable to water.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Burk Royalty Company Lease Cox Well No. WS-1

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	853.1	18.4	43	45	88	614	4.4	1.0	1.0	614	4.40
2	854.1	20.6	54	31	85	863	52.	0.6	1.6	518	31.20
3	855.1	19.1	49	32	81	727	8.4	1.0	2.6	727	8.40
4	856.1	17.1	63	30	93	836	9.3	1.4	4.0	1,170	13.00
5	857.1	16.0	53	35	88	658	6.8	0.6	4.6	390	4.10
6	858.1	17.1	55	39	94	730	1.1	1.0	5.6	730	1.10
7	859.1	17.0	62	27	89	818	6.3	1.0	6.6	818	6.30
8	860.1	15.8	45	47	92	552	0.69	1.0	7.6	552	0.69
9	861.1	18.2	53	37	90	748	6.3	1.0	8.6	748	6.30
10	862.1	19.7	55	35	90	840	6.1	0.6	9.2	504	3.66
11	863.1	20.6	58	20	78	927	0.97	1.4	10.6	1,297	1.36
12	864.1	18.1	43	42	85	604	3.3	1.0	11.6	604	3.30
13	865.1	22.1	41	41	82	703	11.	1.0	12.6	703	11.00
14	866.1	19.7	42	41	83	642	0.40	1.0	13.6	642	0.40
15	867.1	12.0	37	48	85	344	Imp.	1.4	15.0	482	0.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Burk Royalty Company Lease Cox Well No. WS-1

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
853.0 - 857.0	4.0	14.2	57.00
857.0 - 866.6	9.6	4.0	38.21
853.0 - 866.6	13.6	7.0	95.21

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
853.0 - 857.0	4.0	18.4	48.3	34.5	757	3,029
857.0 - 868.0	11.0	17.7	49.0	37.4	679	7,470
853.0 - 868.0	15.0	17.9	48.8	36.6	700	10,499

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Burk Royalty Company Lease Cox Well No. WS-1

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	853.1	18.0	40	559	0	0	40	47	559	24	1.00	-
2	854.1	21.1	54	884	19	311	35	56	573	359	7.80	20
3	855.1	19.7	49	750	12	184	37	57	566	6	0.300	50
4	856.1	16.7	63	816	21	272	42	54	544	0	0.005	40
5	857.1	15.5	50	601	0	0	50	40	601	0	Imp.	
6	858.1	16.7	50	648	0	0	50	45	648	0	Imp.	
7	859.1	17.3	58	779	0	0	58	34	779	0	Imp.	
8	860.1	16.2	43	540	0	0	43	51	540	0	Imp.	
9	861.1	17.7	50	687	0	0	50	44	687	0	Imp.	
10	862.1	19.2	51	760	0	0	51	43	760	0	Imp.	
11	863.1	20.4	55	870	0	0	55	25	870	0	Imp.	
12	864.1	18.5	40	574	0	0	40	49	574	0	Imp.	
13	865.1	21.5	43	717	0	0	43	46	717	0	Imp.	
14	866.1	19.2	40	596	0	0	40	46	596	0	Imp.	
15	867.1	12.6	33	323	0	0	33	54	323	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.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Burk Royalty Company Lease Cox Well No. WS-1

Depth Interval, Feet	854.0 - 857.0
Feet of Core Analyzed	3.0
Average Percent Porosity	18.6
Average Percent Original Oil Saturation	56.6
Average Percent Oil Recovery	17.6
Average Percent Residual Oil Saturation	39.0
Average Percent Residual Water Saturation	55.4
Average Percent Total Residual Fluid Saturation	94.4
Average Original Oil Content, Bbls./A. Ft.	828.
Average Oil Recovery, Bbls./A. Ft.	251.
Average Residual Oil Content, Bbls./A. Ft.	577.
Total Original Oil Content, Bbls./Acre	2,484.
Total Oil Recovery, Bbls./Acre	752.
Total Residual Oil Content, Bbls./Acre	1,732.
Average Effective Permeability, Millidarcys	1.66
Average Initial Fluid Production Pressure, p.s.i.	39.3

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