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

OILFIELD RESEARCH LABORATORIES

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September 26, 1961

Taisha Oil Company
1611 N. Boston Avenue
Tulsa, Oklahoma

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Cyrus Hughes Lease, Well No. 2, Franklin County, Kansas, and submitted to our laboratory on September 19, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

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GENERAL INFORMATION & SUMMARY

Company Taisha Oil Company Lease Cyrus Hughes Well No. 2

Location NW¼ SW¼

Section 2 Twp. 17S Rge. 19E County Franklin State Kansas

Name of Sand	Squirrel
Top of Core	678.0
Bottom of Core	698.0
Top of Sand (Analyzed)	678.0
Bottom of Sand (Analyzed)	694.0
Total Feet of Permeable Sand	14.4
Total Feet of Floodable Sand	6.2

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	2.6	2.6
10 - 50	8.6	11.2
50 - 100	1.5	12.7
100 - 117	1.7	14.4

Average Permeability Millidarcys	44.2
Average Percent Porosity	20.6
Average Percent Oil Saturation	40.8
Average Percent Water Saturation	36.3
Average Oil Content, Bbls./A. Ft.	655.
Total Oil Content, Bbls./Acre	9,423.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.5
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	109.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	679.
Total Calculated Oil Recovery, Bbls./Acre	2,355.
Packer Setting, Feet	-
Viscosity, Centipoises @ 76°F	330.
A. P. I. Gravity, degrees @ 60 °F	21.5
Elevation, Feet	

Fresh water mud was used as the circulating fluid in coring this well. The core was sampled and the samples sealed in tin cans by Oilfield Research Laboratories personnel. The well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
678.0 - 679.2	Grayish brown slightly calcareous sandstone.
679.2 - 679.5	Brown sandstone.
679.5 - 680.2	Shale.
680.2 - 682.6	Dark brown sandstone.
682.6 - 683.5	Gray limestone.
683.5 - 694.0	Dark brown sandstone.
694.0 - 695.5	Gray sandy shale.
695.5 - 698.0	Dark carbonaceous shaley sandstone.

Coring was started at a depth of 678.0 feet in slightly calcareous sandstone and completed at 698.0 feet in shaley sandstone. This core shows a total of 14.4 feet of sandstone. 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 25.9 and 51.0 millidarcys respectively; the overall average being 44.2 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather irregular permeability profile. The permeability of the sand varies from 0.34 to a maximum of 117. millidarcys

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent

oil saturation, namely, 40.8. The weighted average percent oil saturation of the upper and lower sections is 38.6 and 41.5 respectively. The weighted average percent water saturation of the upper and lower sections is 39.6 and 35.2 respectively; the overall average being 36.3 (See Table III). This gives an overall weighted average total fluid saturation of 77.1 percent. This low total fluid saturation indicates considerable fluid was lost during coring most of which was probably oil.

The weighted average oil content of the upper and lower sections is 608 and 671 barrels per acre foot respectively; the overall average being 655. The total oil content, as shown by this core, is 9,423 barrels per acre (See Table III).

VISCOSITY

The viscosity of a sample of crude oil taken from a lease stock tank is 330.0 centipoises at 76 degrees F. The A.P.I. gravity of the oil is 21.5 degrees at 60 degrees F. With other factors being favorable, a sand containing an oil of this viscisity may respond to waterflooding by using proper injection rates. It would appear that low injection rates may be required to minimize the possibility of channeling.

LABORATORY FLOODING TESTS

The sand in this core responded rather poorly to laboratory flooding tests, as a total recovery of 679 barrels of oil per acre was obtained from 6.2 feet of sand. The weighted average percent oil saturation was reduced from 45.3 to 38.8, or represents an average recovery of 6.5 percent. The weighted average effective permeability of the samples is 0.484 millidarcys, while the average initial fluid production pressure is 37.9 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the

16 samples tested, 12 produced water and 7 oil. This indicates that approximately 44 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a somewhat low effective permeability to water.

CONCLUSION

Based on the results of the laboratory tests, it appears that approximately 2,355 barrels of oil per acre could be recovered from the vicinity of this well by efficient primary and secondary methods. The calculated primary recovery is 845 barrels per acre and the calculated water-flood recovery is 1,510 barrels per acre.

The above recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.04
Reservoir water saturation, percent	30.0
Primary recovery, estimated, percent	4.0
Average porosity, percent	21.7
Abandonment oil saturation, percent	38.8
Perofrmance factor, percent	55.0
Net floodable pay sand, feet	6.2

The above recovery was calculated on the assumption that satisfactory injection rates can be maintained.

The core indicates a reservoir having a fairly good oil saturation, a moderate water saturation and a somewhat low effective permeability to water.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Taisha Oil Co. Lease Cyrus Hughes Well No. 2

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	678.1	13.7	34	57	91	362	0.34	1.2	1.2	435	0.41
2	679.3	21.0	43	27	70	701	5.3	0.3	1.5	210	1.59
3	680.4	20.9	32	38	70	519	35.	0.6	2.1	314	21.00
4	681.1	22.6	40	35	75	702	45.	0.8	2.9	562	36.00
5	682.1	23.8	46	27	73	850	42.	1.0	3.9	850	42.00
6	683.6	20.2	32	45	77	501	74.	0.5	4.4	251	37.00
7	684.3	21.5	48	38	86	801	117.	0.7	5.1	561	81.90
8	685.2	21.5	40	34	74	668	50.	1.1	6.2	735	55.00
9	686.5	21.9	42	31	73	714	20.	1.1	7.3	786	22.00
10	687.3	20.4	36	35	71	570	26.	1.0	8.3	570	26.00
11	688.4	22.0	42	31	73	717	116.	1.0	9.3	717	116.00
12	689.5	22.6	44	30	74	772	96.	1.0	10.3	772	96.00
13	690.3	19.9	34	43	77	525	43.	0.9	11.2	473	38.70
14	691.3	20.9	39	42	81	633	26.	1.0	12.2	633	26.00
15	692.5	20.6	41	36	77	656	27.	1.1	13.3	722	29.70
16	693.4	19.1	51	29	80	756	6.4	1.1	14.4	832	7.04
								Total	-------	9,423	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Taisha Oil Co. Lease Cyrus Hughes Well No. 2

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
678.0 - 682.6	3.9	25.9	101.00
683.5 - 694.0	10.5	51.0	535.34
678.0 - 694.0	14.4	44.2	636.34

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
678.0 - 682.6	3.9	19.8	38.6	39.6	608	2,371
683.5 - 694.0	10.5	21.0	41.5	35.2	671	7,052
678.0 - 694.0	14.4	20.6	40.8	36.3	655	9,423

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Taisha Oil Co. Lease Cyrus Hughes Well No. 2

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	678.1	13.4	35	364	0	0	35	58	364	3	0.300	50
2	679.3	21.4	43	714	7	116	36	52	598	8	0.334	40
3	680.4	21.0	30	489	0	0	30	64	489	3	0.300	50
4	681.1	22.5	38	664	0	0	38	39	664	0	Imp.	50+
5	682.1	23.5	46	839	7	128	39	55	711	5	0.334	45
6	683.6	20.6	34	544	0	0	34	59	544	19	0.556	30
7	684.3	21.9	48	816	14	238	34	55	578	30	0.900	30
8	685.2	21.1	39	638	0	0	39	37	638	0	Imp.	50+
9	686.5	21.5	42	701	6	100	36	54	601	7	0.334	40
10	687.3	20.4	38	601	0	0	38	35	601	0	Imp.	50+
11	688.4	21.7	42	708	3	51	39	55	657	1	0.100	50
12	689.5	22.9	44	782	5	89	39	47	693	45	1.10	25
13	690.3	20.3	37	583	0	0	37	57	583	9	0.300	35
14	691.3	21.1	39	638	0	0	39	52	638	11	0.334	35
15	692.5	20.1	38	593	0	0	38	40	593	0	Imp.	50+
16	693.4	19.3	51	764	6	90	45	51	674	11	0.334	35

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 Taisha Oil Co. Lease Cyrus Hughes Well No. 2

Depth Interval, Feet	678.0 - 682.6	683.5 - 694.0	678.0 - 694.0
Feet of Core Analyzed	1.3	4.9	6.2
Average Percent Porosity	23.0	21.4	21.7
Average Percent Original Oil Saturation	45.3	45.3	45.3
Average Percent Oil Recovery	7.0	6.3	6.5
Average Percent Residual Oil Saturation	38.3	39.0	38.8
Average Percent Residual Water Saturation	54.4	52.3	52.6
Average Percent Total Residual Fluid Saturation	92.7	91.3	91.4
Average Original Oil Content, Bbls./A. Ft.	811.	749.	760.
Average Oil Recovery, Bbls./A. Ft.	126.	105.	109.
Average Residual Oil Content, Bbls./A. Ft.	685.	644.	651.
Total Original Oil Content, Bbls./Acre	1,053.	3,673.	4,726.
Total Oil Recovery, Bbls./Acre	163.	516.	679.
Total Residual Oil Content, Bbls./Acre	890.	3,157.	4,047.
Average Effective Permeability, Millidarcys	0.334	0.525	0.484
Average Initial Fluid Production Pressure, p.s.i.	42.5	36.0	37.9

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