(10)

elevation

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Bros. Lease Teichgraber Well No. 4

Location Center SE SW

Section 14 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2349.0
Bottom of Core	2365.0
Top of Sand (Analyzed)	2349.0
Bottom of Sand	2363.6
Total Feet of Permeable Sand	11.0
Total Feet of Floodable Sand	11.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
3 - 10	3.0	3.0
10 - 20	3.0	6.0
20 - 50	2.0	8.0
50 - 100	2.0	10.0
100 & above	1.0	11.0

Average Permeability Millidarcys	33.1
Average Percent Porosity	17.5
Average Percent Oil Saturation	25.2
Average Percent Water Saturation	52.6
Average Oil Content, Bbls./A. Ft.	340.
Total Oil Content, Bbls./Acre	4,972.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.0
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	88.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	964.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	2,890.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Jackson Bros. Lease Teichgraber Well No. 4

Depth Interval, Feet	2349.0 - 2363.6
Feet of Core Analyzed	11.0
Average Percent Porosity	18.6
Average Percent Original Oil Saturation	27.2
Average Percent Oil Recovery	6.0
Average Percent Residual Oil Saturation	21.2
Average Percent Residual Water Saturation	70.3
Average Percent Total Residual Fluid Saturation	91.5
Average Original Oil Content, Bbls./A. Ft.	376.
Average Oil Recovery, Bbls./A. Ft.	88.
Average Residual Oil Content, Bbls./A. Ft.	288.
Total Original Oil Content, Bbls./Acre	4,127.
Total Oil Recovery, Bbls./Acre	964.
Total Residual Oil Content, Bbls./Acre	3,163.
Average Effective Permeability, Millidarcys	2.41
Average Initial Fluid Production Pressure, p.s.i.	26.4

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

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in plastic bags by a representative of Oilfield Research Laboratories. The well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
2349.0 - 2351.6	Grayish light brown, shaly sandstone.
2351.6 - 2363.6	Light brown, slightly shaly sandstone.
2363.6 - 2365.0	Shale.

Coring was started at a depth of 2349.0 feet in shaly sandstone and completed at 2365.0 feet in shale. This core shows a total of 14.6 feet of sandstone. For the most part, the pay is made up of light brown, slightly shaly 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 4.8 and 39.4 millidarcys respectively; the overall average being 33.1 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has an irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 118. millidarcys.

PERCENT SATURATION & OIL CONTENT

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

oil saturation, namely, 25.2. The weighted average percent oil saturation of the upper and lower sections is 25.3 and 25.1 respectively. The weighted average percent water saturation of the upper and lower sections is 57.6 and 49.6 respectively; the overall average being 52.6 (See Table III). This gives an overall weighted average total fluid saturation of 77.8 percent. This low total fluid saturation indicates considerable fluid was lost during coring most of which was probably oil.

In an effort to determine whether or not any flushing of the sand occurred during coring, all 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 considerable flushing occurred since the zones of higher permeability show the lower chloride content.

The weighted average oil content of the upper and lower sections is 296 and 370 barrels per acre foot respectively; the overall average being 340. The total oil content, as shown by this core, is 4,972 barrels per acre of which 4,127 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 964 barrels of oil per acre was obtained from 11.0 feet of sand. The weighted average percent oil saturation was reduced from 27.2 to 21.2, or representes an average recovery of 6.0 percent. The weighted average effective permeability of the samples is 2.41 millidarcys, while the average initial fluid production pressure is 26.4

pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 15 samples tested, 11 produced water and oil. This indicates that approximately 73 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 to water.

CONCLUSION

Based on the results of the laboratory tests, it appears that efficient primary and secondary operations in the vicinity of this well should recover approximately 2,890 barrels of oil per acre or an average of 263 barrels per acre foot from the 11.0 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.21
Reservoir water saturation, percent	35.0
Average porosity, percent	18.6
Oil saturation after flooding, percent	21.2
Performance factor, percent	50.0
Net floodable pay sand, feet	11.0

This core shows a pay sand section having a good oil saturation, a moderate water saturation and a wide variation in effective permeability to water.

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Bros. Lease Teichgraber Well No. 4

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
2349.0 - 2354.6	2.0	4.8	9.50
2354.6 - 2363.6	9.0	39.4	354.30
2349.0 - 2363.6	11.0	33.1	363.80

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
2349.0 - 2354.6	5.6	15.1	25.3	57.6	296	1,651
2354.6 - 2363.6	9.0	19.0	25.1	49.6	370	3,321
2349.0 - 2363.6	14.6	17.5	25.2	52.6	340	4,972

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RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VI

Company Jackson Bros. Lease Teichgraber Well No. 4

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2349.1	132,000			
2	2350.1	105,700			
3	2351.1	100,700			
4	2352.1	92,400			
5	2353.1	100,700			
6	2354.1	106,600			
7	2355.1	30,525			
8	2356.1	28,925			
9	2357.1	75,500			
10	2358.1	11,820			
11	2359.1	28,400			
12	2360.1	69,550			
13	2361.1	94,550			
14	2362.1	29,820			
15	2363.1	12,855			

Note: ppm — parts per million

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Bros. Lease Teichgraber Well No. 4

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	2349.1ss	15.3	23	71	94	273	0 Imp.	0.6	0.6	164	0.00
2	2350.1ss	15.9	24	60	84	296	Imp.	1.0	1.6	296	0.00
3	2351.1ss	15.5	13	46	59	156	Imp.	1.0	2.6	156	0.00
4	2352.1Δ	15.8	30	57	87	368	6 5.6	1.0	3.6	368	5.60
5	2353.1Δ	15.8	33	55	88	404	5 3.9	1.0	4.6	404	3.90
6	2354.1Δ	12.1	28	62	90	263	4 Imp.	1.0	5.6	263	0.00
7	2355.1X	16.6	26	47	73	335	9 14. 38.5	1.0	6.6	335	14.00
8	2356.1X	20.0	28	46	74	434	8 13. 30	1.0	7.6	434	13.00
9	2357.1X	17.5	24	54	78	326	7 8.3	1.0	8.6	326	8.30
10	2358.1X	19.1	24	51	75	356	10 17. 47	1.0	9.6	356	17.00
11	2359.1X	18.5	22	52	74	316	12 29. 64	1.0	10.6	316	29.00
12	2360.1X	18.3	33	49	82	468	11 23. 55.5	1.0	11.6	468	23.00
13	2361.1X	16.4	23	51	74	293	14 72. 83	1.0	12.6	293	72.00
14	2362.1X	21.9	23	45	68	391	13 60. 72.5	1.0	13.6	391	60.00
15	2363.1X	22.5	23	51	74	402	15 118. 91.5	1.0	14.6	402	118.00
								Total		4,972	

8.5%

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Bros. Lease Teichgraber Well No. 4

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	2349.1	15.0	24	279	0	0	24	72	279	0	Imp.	-
2	2350.1	15.9	23	284	0	0	23	62	284	0	Imp.	-
3	2351.1	15.5	14	168	0	0	14	46	168	0	Imp.	-
4	2352.1	16.2	30	377	2	25	28	63	352	4	0.180	50
5	2353.1	16.0	33	409	4	50	29	66	359	6	0.200	50
6	2354.1	12.4	30	288	0	0	30	63	288	0	Imp.	-
7	2355.1	17.1	26	345	2	27	24	63	318	30	0.641	30
8	2356.1	19.6	28	426	8	122	20	71	304	52	1.10	30
9	2357.1	18.0	24	334	7	98	17	70	236	24	0.575	30
10	2358.1	19.3	24	359	7	105	17	81	254	55	1.70	10
11	2359.1	18.6	22	318	5	72	17	72	246	63	0.835	20
12	2360.1	18.8	33	481	17	248	16	76	233	172	5.50	20
13	2361.1	16.7	23	298	5	65	18	66	233	72	1.92	20
14	2362.1	21.5	23	384	5	83	18	69	301	50	1.20	20
15	2363.1	22.2	23	396	4	69	19	76	327	361	12.60	10

Notes: cc--cubic centimeter.

*--Volume of water recovered at the time of maximum oil recovery.

~ termined by passing water through sample which still contains resid oil.

Oilfield Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Bros. Lease Teichgraber Well No. 4

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
2349.0 - 2354.6	104,500		
2354.6 - 2363.6	42,450		
2349.0 - 2363.6	66,200		

Note: ppm — parts per million.