Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Crews Well No 5

Location

Section 3 Twp 26S Rge 8E County Greenwood State Kansas

Name of Sand	Peru
Top of Core	2373.0
Bottom of Core	2390.0
Top of Sand	2377.0
Bottom of Sand	2386.0
Total Feet of Permeable Sand	3.8
Total Feet of Floodable Sand	-

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	2.0	2.0
5 & above	1.8	3.8

Average Permeability Millidarcys	7.4
Average Percent Porosity	12.2
Average Percent Oil Saturation	10.4
Average Percent Water Saturation	81.2
Average Oil Content, Bbls./A. Ft.	88.
Total Oil Content, Bbls./Acre	667.
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 Oil Recovery, Bbls./Acre	
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Crews Well No. 5

Location

Section 3 Twp. 26S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2518.0
Bottom of Core	2546.0
Top of Sand	2526.2
Bottom of Sand	2542.2
Total Feet of Permeable Sand	14.6
Total Feet of Floodable Sand	13.0

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	3.5	3.5
5 - 10	2.1	5.6
10 - 20	4.0	9.6
20 - 30	4.0	13.6
30 & above	1.0	14.6

Average Permeability Millidarcys	15.0
Average Percent Porosity	18.9
Average Percent Oil Saturation	21.8
Average Percent Water Saturation	57.7
Average Oil Content, Bbls./A. Ft.	324.
Total Oil Content, Bbls./Acre	5,609.
Average Percent Oil Recovery by Laboratory Flooding Tests	3.5
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	55.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	712.
Total Calculated Oil Recovery, Bbls./Acre	2,500.
Packer Setting, Feet	
Viscosity, Centipoises @	
A.P.I. Gravity, degrees @ 60 °F	
Elevation, Feet	

A water base mud was used as the circulating fluid during the coring of both sands. Samples were taken from the cores and sealed in plastic bags by a representative of Oilfield Research Laboratories.

Porosity, oil and water saturations, permeability and effective permeability tests were run on the Peru sand. A complete analysis was run on the Bartlesville sand.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
	PERU SAND
2373.0 - 2377.0	Shale (Discarded at well).
2377.0 - 2380.2	Gray shaley micaceous sandstone.
2380.2 - 2381.7	Gray calcareous slightly micaceous sandstone containing a vertical fracture.
2381.7 - 2386.0	Gray laminated shaley sandstone.
2386.0 - 2390.0	Sandy shale (Discarded at well).
2390.0 - 2518.0	Drilled with tools.
	BARTLESVILLE SAND
2518.0 - 2524.0	Shale (Discarded at well).
2524.0 - 2525.3	Gray rotten shale.
2525.3 - 2526.0	Brownish gray shaley sandstone.
2526.0 - 2526.2	Grayish light brown shaley sandstone.
2526.2 - 2537.2	Light brown sandstone.
2537.2 - 2538.0	Grayish light brown shaley sandstone.
2538.0 - 2538.2	Light brown sandstone.
2538.2 - 2542.2	Grayish light brown laminated micaceous shaley sandstone.
2542.2 - 2543.3	Gray rotten shale.
2543.3 - 2544.5	Gray shaley sandstone.
2544.5 - 2545.0	Black rotten shale.
2545.0 - 2546.0	Black shale (Discarded at well).

Coring of the Peru sand was started at a depth of 2373.0 feet in shale and completed at 2390.0 feet in sandy shale. Coring of the Bartlesville sand was started at 2518.0 feet in shale and completed at 2546.0 feet in black shale. The cores show 9.0 and 18.1 feet of sand, respectively, in the Peru and Bartlesville sections.

The following discussion is concerned with the complete analysis run on the Bartlesville core.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 18.4 and 4.7 millidarcys respectively; the overall average being 15.0 (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 0.68 to a maximum of 54 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 21.8. The weighted average percent oil saturation of the upper and lower sections is 22.3 and 20.3 respectively. The weighted average percent water saturation of the upper and lower sections is 54.5 and 64.4 respectively; the overall average being 57.7 (See Table III). This gives an overall weighted average total fluid saturation of 79.5 percent. This total fluid saturation indicates some fluid was lost during coring part of which probably was oil.

The weighted average oil content of the upper and lower sections is 344 and 280 barrels per acre foot respectively; the overall average being 324. The total oil content, as shown by this core, is 5,609 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 712 barrels of oil per acre was obtained from 13.0 feet of sand. The weighted average percent oil saturation was reduced from 23.3 to 19.8, or represents an average recovery of 3.5 percent. The weighted average effective permeability of the samples is 2.98 millidarcys, while the average initial fluid production pressure is 26.9 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 19 samples tested, 14 produced water and 13 oil. This indicates that approximately 68 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a rather wide variation in effective permeability.

CONCLUSION

It is evident from the enclosed data that an efficient water-flood will recover approximately 2,500 barrels of oil per acre from the area of which this core is representative. This represents an average recovery of 192 barrels of oil per acre foot from the 13.0 feet of floodable pay sand analyzed. The following factors and assumptions were used in calculating this recovery:

Original formation volume factor	1.19
Present formation volume factor	1.05
True water saturation, percent	42.0
Primary oil recovery, percent	5.0
Calculated present oil saturation, percent	46.2
Porosity, percent	19.9
Oil saturation at abandonment, percent	20.0
Performance factor, percent	50.0

The analysis results show 13.0 feet of floodable pay sand in the interval extending from 2526.2 to 2542.2 feet. The pay sand has fairly low oil and rather high water saturations. This is probably partly due to flushing of the sand with coring fluid. The pay sand has a rather wide variation in effective permeability. However, the sand for the most part has good permeability for the depth and no difficulty should be encountered in forcing it to take the necessary volume of properly conditioned water.

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Jackson Brothers Lease Crews Well No. 5

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
		PERU SAND			
1	2377.8	0.79	0.8	0.8	0.63
2	2378.9	1.2	0.6	1.4	0.72
3	2379.9	5.5	0.6	2.0	3.30
4	2380.9	Imp.	0.6	2.6	0.00
5	2381.9	8.6	0.6	3.2	5.16
6	2382.9	4.3	0.6	3.8	2.58
7	2383.9	26.	0.6	4.4	15.60
		BARTLESVILLE SAND			
8	2525.6	Imp.	0.4	0.4	0.00
9	2525.9	Imp.	0.3	0.7	0.00
10	2526.4	2.9	0.4	1.1	1.16
11	2526.9	3.5	0.5	1.6	1.75
12	2527.4	8.3	0.5	2.1	4.15
13	2527.9	18.	0.5	2.6	9.00
14	2528.4	22.	0.5	3.1	11.00
15	2528.9	23.	0.5	3.6	11.50
16	2529.4	11.	0.5	4.1	5.50
17	2529.9	22.	0.5	4.6	11.00
18	2530.4	25.	0.5	5.1	12.50
19	2530.9	28.	0.5	5.6	14.00
20	2531.4	19.	0.5	6.1	9.50
21	2531.9	13.	0.5	6.6	6.50
22	2532.4	21.	0.5	7.1	10.50
23	2532.9	24.	0.5	7.6	12.00
24	2533.4	19.	0.5	8.1	9.50
25	2533.9	34.	0.5	8.6	17.00
26	2534.4	20.	0.5	9.1	10.00
27	2534.9	17.	0.5	9.6	8.50
28	2535.4	54.	0.5	10.1	27.00
29	2535.9	7.7	0.5	10.6	3.85
30	2536.4	5.4	0.5	11.1	2.70
31	2536.9	6.8	0.6	11.7	4.08
32	2537.4	Imp.	0.4	12.1	0.00
33	2537.9	Imp.	0.4	12.5	0.00
34	2538.4	Imp.	0.4	12.9	0.00
35	2538.9	13.	0.5	13.4	6.50
36	2539.4	3.3	0.5	13.9	1.65
37	2539.9	1.1	0.5	14.4	0.55
38	2540.4	12.	0.5	14.9	6.00

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Jackson Brothers Lease Crews Well No. 5

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
39	2540.9	0.99	0.5	15.4	0.50
40	2541.4	0.68	0.5	15.9	0.34
41	2541.9	2.3	0.6	16.5	1.38
42	2543.9	Imp.	0.8	17.3	0.00
43	2544.4	Imp.	0.4	17.7	0.00

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RESULTS OF SATURATION TESTS

TABLE II

Company Jackson Brothers Lease Crews Well No. 5

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
				PERU SAND					
1	2378.1	7.5	7	83	90	41	1.6	1.6	66
2	2379.1	11.3	14	75	89	123	1.0	2.6	123
3	2380.1	14.1	8	87	95	88	0.6	3.2	53
4	2381.1	6.4	19	74	93	94	1.5	4.7	141
5	2382.1	16.1	10	87	97	125	0.9	5.6	113
6	2383.1	18.5	4	85	89	57	1.0	6.6	57
7	2384.1	18.3	8	83	91	114	1.0	7.6	114
							Total-	- - - - - -	- - 667
				BARTLESVILLE SAND					
8	2525.4	12.2	16	76	92	151	0.7	0.7	106
9	2526.1	17.9	20	62	82	278	0.2	0.9	56
10	2527.1	19.9	21	55	76	324	1.4	2.3	454
11	2528.1	20.9	21	55	76	341	1.0	3.3	341
12	2529.1	20.0	26	51	77	404	1.0	4.3	404
13	2530.1	18.4	22	53	75	314	1.0	5.3	314
14	2531.1	19.4	23	53	76	346	1.0	6.3	346
15	2532.1	19.0	26	54	80	383	1.0	7.3	383
16	2533.1	20.4	26	51	77	412	1.0	8.3	412
17	2534.1	21.4	21	53	74	349	1.0	9.3	349
18	2535.1	20.4	23	54	77	364	1.0	10.3	364
19	2536.1	21.0	24	51	75	391	1.0	11.3	391
20	2537.1	20.3	19	53	72	299	0.6	11.9	179
21	2538.1	21.0	13	54	67	212	0.2	12.1	42
22	2539.1	18.0	24	59	83	335	1.4	13.5	470
23	2540.1	15.5	19	65	84	228	1.0	14.5	228

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RESULTS OF SATURATION TESTS

TABLE II

Company Jackson Brothers Lease Crews Well No. 5

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
24	2541.1	17.5	24	63	87	326	1.0	15.5	326
25	2542.1	21.1	29	43	72	475	0.6	16.1	285
26	2544.1	15.6	11	84	95	133	1.2	17.3	159
							Total-	- - - - - -	- 5,609

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Brothers Lease Crews Well No. 5

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
	PERU SAND		
2377.4 - 2384.2	3.8	7.4	27.99
	BARTLESVILLE SAND		
2526.2 - 2537.2	11.0	18.4	202.69
2538.6 - 2542.2	3.6	4.7	16.92
2526.2 - 2542.2	14.6	15.0	219.61

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
			PERU SAND			
2377.0 - 2384.6	7.6	12.2	10.4	81.2	88	667
			BARTLESVILLE SAND			
2525.3 - 2537.2	11.9	19.6	22.3	54.5	344	4,099
2538.0 - 2544.5	5.4	17.4	20.3	64.4	280	1,510
2525.3 - 2544.5	17.3	18.9	21.8	57.7	324	5,609

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Crews Well No. 5

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.			
						PERU SAND						
1	2378.1										0.295	
2	2379.1										1.59	
3	2380.1										0.500	
4	2381.1										Imp.	
5	2382.1										2.30	
6	2383.1										6.80	
7	2384.1										5.07	
						BARTLESVILLE SAND						
8	2525.4	11.7	13	118	0	0	13	79	118	0	Imp.	50+
9	2526.1	18.2	17	240	0	0	17	78	240	0	Imp.	50+
10	2527.1	20.0	21	326	3	47	18	75	279	14	0.400	30
11	2528.1	21.4	21	349	5	83	16	77	266	163	6.36	20
12	2529.1	20.3	26	409	4	63	22	74	346	110	6.75	20
13	2530.1	18.9	22	322	2	29	20	77	293	101	3.00	20
14	2531.1	18.8	23	335	2	29	21	78	306	32	0.820	30
15	2532.1	18.4	26	371	2	29	24	70	342	33	1.00	30
16	2533.1	20.6	26	416	6	96	20	76	320	83	4.42	30
17	2534.1	21.2	21	345	1	16	20	71	329	67	2.52	30
18	2535.1	20.0	23	357	6	93	17	78	264	112	9.38	20
19	2536.1	20.8	24	388	5	81	19	76	307	37	0.982	30
20	2537.1	19.7	19	290	3	46	16	81	244	90	2.30	20
21	2538.1	20.7	13	208	0	0	13	74	208	0	Imp.	50+
22	2539.1	18.4	24	343	4	57	20	77	286	35	0.967	30
23	2540.1	15.8	22	270	0	0	22	73	270	7	0.297	45
24	2541.1	17.0	23	303	0	0	23	73	303	0	Imp.	50+
25	2542.1	20.9	29	470	2	32	27	65	438	13	0.300	40
26	2544.1	15.4	11	131	0	0	11	86	131	0	Imp.	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

Company Jackson Brothers Lease Crews Well No. 5

BARTLESVILLE SAND

Depth Interval, Feet	2526.2 - 2537.2	2538.2 - 2542.2	2526.2 - 2542.2
Feet of Core Analyzed	11.0	2.0	13.0
Average Percent Porosity	20.0	19.2	19.9
Average Percent Original Oil Saturation	22.9	35.5	23.3
Average Percent Oil Recovery	3.5	3.4	3.5
Average Percent Residual Oil Saturation	19.4	22.1	19.8
Average Percent Residual Water Saturation	75.5	73.4	75.2
Average Percent Total Residual Fluid Saturation	94.9	95.5	95.0
Average Original Oil Content, Bbls./A. Ft.	357.	381.	361.
Average Oil Recovery, Bbls./A. Ft.	56.	50.	55.
Average Residual Oil Content, Bbls./A. Ft.	301.	331.	306.
Total Original Oil Content, Bbls./Acre	3,923.	762.	4,685.
Total Oil Recovery, Bbls./Acre	613.	99.	712.
Total Residual Oil Content, Bbls./Acre	3,310.	663.	3,973.
Average Effective Permeability, Millidarcys	3.38	0.767	2.98
Average Initial Fluid Production Pressure, p.s.i.	25.5	35.0	26.9

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