

Oilfield Research Laboratories
GENERAL INFORMATION & SUMMARY

Look up 10
elevation
1484

Company Jackson Bros. Lease Hawthorne Well No. 6

Location NE NW NE

Section 27 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand - - - - - Bartlesville

Top of Core - - - - - 2510.0

Bottom of Core - - - - - 2542.0

Top of Sand - - - - - (Analyzed) - - - - - 2512.6

Bottom of Sand - - - - - 2541.0

Total Feet of Permeable Sand - - - - - 22.0

Total Feet of Floodable Sand - - - - - 15.0

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

0 - 5	2.6	2.6
5 - 10	3.0	5.6
10 - 20	3.0	8.6
20 - 50	11.0	19.6
50 & above	2.4	22.0

Average Permeability Millidarcys - - - - - 25.8

Average Percent Porosity - - - - - 18.4

Average Percent Oil Saturation - - - - - 20.4

Average Percent Water Saturation - - - - - 68.0

Average Oil Content, Bbls./A. Ft. - - - - - 294.

Total Oil Content, Bbls./Acre - - - - - 6,776.

Average Percent Oil Recovery by Laboratory Flooding Tests - - - - - 7.5

Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. - - - - - 113.

Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre - - - - - 1,697.

Total Calculated Oil Recovery, Bbls./Acre - (Primary & Secondary) - - - - - 5,560

Packer Setting, Feet - - - - -

Viscosity, Centipoises @ - - - - -

A. P. I. Gravity, degrees @ 60 °F - - - - -

Elevation, Feet - - - - - 1482.0 G.L.

27-25-8E

Hawthorne 6

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in cans 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:

<u>Depth Interval, Feet</u>	<u>Description</u>
2510.0 - 2511.5	- Dark shale.
2511.5 - 2515.0	- Gray shaly sandstone.
2515.0 - 2516.5	- Rotten shale.
2516.5 - 2519.0	- Sandy shale.
2519.0 - 2541.0	- Light brown, slightly shaly sandstone.
2541.0 - 2542.0	- Shale.

Coring was started at a depth of 2510.0 feet in shale and completed at 2542.0 feet also in shale. 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 21.2 and 30.0 millidarcys respectively; the overall average being 25.8 (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 impermeable to a maximum of 59. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 20.4. The weighted average percent oil saturation of the upper and lower sections is 24.8 and 16.2 respectively. The weighted average percent water saturation of the upper and lower sections

is 64.0 and 72.1 respectively; the overall average being 68.0 (See Table III). This gives an overall weighted average total fluid saturation of 88.4 percent.

In an effort to determine whether or not any flushing of the sand occurred during coring, all 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 of the sand occurred during coring operations.

The weighted average oil content of the upper and lower sections is 366 and 222 barrels per acre foot respectively; the overall average being 294. The total oil content, as shown by this core, is 6,776 barrels per acre of which 5,452 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 1,697 barrels of oil per acre was obtained from 15.0 feet of sand. The weighted average percent oil saturation was reduced from 24.4 to 16.9, or represents an average recovery of 7.5 percent. The weighted average effective permeability of the samples is 1.90 millidarcys, while the average initial fluid production pressure is 26.6 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 23 samples tested, 21 produced water and 15 oil. This indicates that approximately 65 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 3,300 and 2,260 barrels of oil per acre respectively. These are average recoveries of 183 and 151 barrels per acre foot respectively. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.21
Reservoir water saturation, percent	40.0
Primary recovery, estimated, percent	15.0
Average porosity, percent	19.1
Oil saturation after flooding, percent	16.9
Performance factor, percent	50.0
Net floodable pay sand, feet	15.0

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.

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

[illegible]

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company		Lease		Hawthorne		Well No.	
Jackson Bros.						6	
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.				
2512.6 - 2529.6	10.6	21.2	225.55				
2529.6 - 2541.0	11.4	30.0	342.20				
2512.6 - 2541.0	22.0	25.8	567.75				
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	
2512.6 - 2529.6	11.6	18.9	24.8	64.0	366	4,249	
2529.6 - 2541.0	11.4	18.0	16.2	72.1	222	2,527	
2512.6 - 2541.0	23.0	18.4	20.4	68.0	294	6,776	

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REPORT OF LABORATORY FINDINGS

11-17

Jackson Bros.

Hawthorne

6

Sample No.	Sample Type	Original Concentration		Concentration		Recovery Factor		Vol. of Water Sample	Impurity Factor	Total Impurity
		S	ML/AIR	S	ML/AIR	S	ML/AIR			
1	2513.1	16	183	0	0	16	81	0	Imp.	-
2	2519.1	21	240	0	0	21	73	0	Imp.	-
3	2520.1	15	243	0	0	16	70	10	.400	50
4	2521.1	27	431	9	144	18	71	121	3.30	20
5	2522.1	20	316	3	47	17	76	60	1.50	30
6	2523.1	40	616	22	339	18	77	10	.300	40
7	2524.1	24	372	7	108	17	74	37	.900	30
8	2525.1	24	368	5	77	19	73	64	1.50	20
9	2526.1	28	404	10	144	18	75	30	.700	30
10	2527.1	24	390	9	146	15	78	202	5.00	20
11	2528.1	28	423	11	166	17	77	48	1.30	30
12	2529.1	31	469	15	226	16	82	30	.800	30
13	2530.1	20	292	3	44	17	82	152	3.80	10
14	2531.1	12	167	0	0	12	82	121	3.30	20
15	2532.1	23	303	7	92	16	77	44	1.00	20
16	2533.1	18	266	2	30	16	73	8	.300	50
17	2534.1	15	218	0	0	15	83	106	3.40	20
18	2535.1	16	234	0	0	16	83	281	7.40	10
19	2536.1	23	306	6	80	17	79	24	.600	30
20	2537.1	16	219	0	0	16	80	29	.600	30
21	2538.1	20	250	2	25	18	79	71	1.70	20
22	2539.1	17	246	2	29	15	83	223	5.80	20
23	2540.1	7	108	0	0	7	85	93	2.60	20

Notes: 1. Original concentration.

2. Volume of water recovered at the time of maximum oil recovery.

3. Determined by passing water through sample which still contains residual oil.

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RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VI

Company Jackson Bros. Lease Hawthorne Well No. 6

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2513.1	80,400			
2	2519.1	91,550			
3	2520.1	82,450			
4	2521.1	91,000			
5	2522.1	79,900			
6	2523.1	88,850			
7	2524.1	93,000			
8	2525.1	93,300			
9	2526.1	103,700			
10	2527.1	24,750			
11	2528.1	75,600			
12	2529.1	72,200			
13	2530.1	76,150			
14	2531.1	81,100			
15	2532.1	95,000			
16	2533.1	27,775			
17	2534.1	42,425			
18	2535.1	15,750			
19	2536.1	99,200			
20	2537.1	27,150			
21	2538.1	50,100			
22	2539.1	8,655			
23	2540.1	7,400			

Note: ppm — parts per million

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE 7

Company	Jackson Bros.	Hawthorne	Well No.	6
Depth Interval, Feet	2512.6 - 2529.6	2529.6 - 2541.0	2512.6 - 2541.0	
Feet of Core Analyzed	9.0	6.0	15.0	
Average Percent Porosity	19.9	17.8	19.1	
Average Percent Original Oil Saturation	27.3	20.2	24.4	
Average Percent Oil Recovery	10.1	3.7	7.5	
Average Percent Residual Oil Saturation	17.2	16.5	16.9	
Average Percent Residual Water Saturation	75.9	78.9	77.0	
Average Percent Total Residual Fluid Saturation	93.1	95.4	93.9	
Average Original Oil Content, Ebbls./A. Ft.	421.	278.	363.	
Average Oil Recovery, Ebbls./A. Ft.	155.	50.	113.	
Average Residual Oil Content, Ebbls./A. Ft.	266.	228.	250.	
Total Original Oil Content, Ebbls./Acre	3,789.	1,663.	5,452.	
Total Oil Recovery, Ebbls./Acre	1,397.	300.	1,697.	
Total Residual Oil Content, Ebbls./Acre	2,392.	1,363.	3,755.	
Average Effective Permeability, Millidarcys	1.70	2.20	1.90	
Average Initial Fluid Production Pressure, p.s.i.	27.8	25.0	26.6	

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

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Bros. Lease Hawthorne Well No. 6

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
2512.6 - 2529.6	81,050		
2529.6 - 2541.0	46,750		
2512.6 - 2541.0	64,050		

Note: ppm — parts per million.