

More

10

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Bros. Lease Hawthorne Well No. 8

Location _____

Section 22 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	- - - - -	Bartlesville
Top of Core	- - - - -	2377.0
Bottom of Core	- - - - -	2389.0
Top of ^{Permeable} Sand	- - - - -	2381.6
Bottom of Sand	- - - - -	2389.0
Total Feet of Permeable Sand	- - - - -	6.0
Total Feet of Floodable Sand	- - - - -	4.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 3	1.6	1.6
3 - 10	3.0	4.6
10 & above	1.4	6.0

Average Permeability Millidarcys	- - - - -	9.8
Average Percent Porosity	- - - - -	15.9
Average Percent Oil Saturation	- - - - -	20.7
Average Percent Water Saturation	- - - - -	35.7
Average Oil Content, Bbls./A. Ft.	- - - - -	256.
Total Oil Content, Bbls./Acre	- - - - -	3,072.
Average Percent Oil Recovery by Laboratory Flooding Tests	- - - - -	4.2
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	- - - - -	49.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	- - - - -	166.
Total Calculated Oil Recovery, Bbls./Acre - (Primary & Secondary)	- - - - -	1,522.
Packer Setting, Feet	- - - - -	
Viscosity, Centipoises @	- - - - -	
A. P. I. Gravity, degrees @ 60 °F	- - - - -	
Elevation, Feet	- - - - -	

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOCCING TESTS

TABLE V

Company	Jackson Bros.	Hawthorne	Well No.	8
Depth Interval, Feet	2385.6 - 2389.0			
Feet of Core Analyzed	3.4			
Average Percent Porosity	19.0			
Average Percent Original Oil Saturation	23.0			
Average Percent Oil Recovery	4.2			
Average Percent Residual Oil Saturation	18.8			
Average Percent Residual Water Saturation	74.0			
Average Percent Total Residual Fluid Saturation	92.8			
Average Original Oil Content, Bbls./A. Ft.	324.			
Average Oil Recovery, Bbls./A. Ft.	49.			
Average Residual Oil Content, Bbls./A. Ft.	275.			
Total Original Oil Content, Bbls./Acre	1,102.			
Total Oil Recovery, Bbls./Acre	166.			
Total Residual Oil Content, Bbls./Acre	936.			
Average Effective Permeability, Millidarcys	0.38			
Average Initial Fluid Production Pressure, p.s.i.	41.8			

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

Oilfield Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Bros. Lease Hawthorne Well No. 8

<u>Depth Interval, Feet</u>	<u>Chloride Content of Brine in Sand, ppm</u>	<u>Average Percent Connate Water</u>	<u>Average Percent Drilling & Foreign Water</u>
2377.0 - 2381.6	145,837		
2381.6 - 2389.0	149,858		
2377.0 - 2389.0	148,317		

Note: ppm — parts per million.

A fresh water mud was used as a circulating fluid in the coring of the sand in this well. This well was drilled in a virgin area. The core was sampled and sealed in tin cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
2377.0 - 2381.0	Gray shaly sandstone.
2381.0 - 2384.0	Grayish light brown, shaly sandstone.
2384.0 - 2389.0	Light brown, slightly shaly sandstone.

Coring was started at a depth of 2377.0 feet in gray shaly sandstone and completed at 2389.0 feet in light brown, slightly shaly sandstone. This core shows a total of 12.0 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 0 and 9.8 millidarcys respectively (See Table III). By observing the data given on the coregraph, it is noticeable that the sand is very tight.

The permeability of the sand varies from impermeable to a maximum of 29. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 20.7. The weighted average percent oil saturation of the upper and lower sections is 19.0 and 21.8 respectively. The weighted average percent water saturation of the upper and lower sections is 42.8 and 31.3 respectively; the overall average being 35.7 (See Table III). This gives an overall weighted average total fluid saturation of 56.4 percent. This low total fluid saturation indicates considerable

fluid was lost during coring which was probably oil.

The above data shows that the pay sand extends from 2381.6 to 2389.0 feet (lower section).

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 very little flushing of the sand occurred during the cutting of the core.

The weighted average oil content of the upper and lower sections is 196 and 293 barrels per acre foot respectively; the overall average being 256. The total oil content, as shown by this core, is 3,072 barrels per acre of which 2,168 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The sand in this core did not respond very well to laboratory flooding tests, as a total recovery of 166 barrels of oil per acre was obtained from 3.4 feet of sand. The weighted average percent oil saturation was reduced from 23.0 to 18.8, or represents an average recovery of 4.2 percent. The weighted average effective permeability of the samples is 0.38 millidarcys, while the average initial fluid production pressure is 41.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 12 samples tested, 5 produced water and 3 oil. This indicates that approximately 25 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

On the basis of the above data, it is evident that approximately 570 barrels of oil per acre can be recovered from the area, represented

OILFIELD RESEARCH LABORATORIES

-4-

by this core, by efficient primary production methods. An additional oil recovery of approximately 952 barrels per acre can be expected from efficient water-flooding. The following data and assumptions were used in calculating the above oil recovery values:

Original formation volume factor	1.20
Present formation volume factor	
Irreducible water saturation, percent	0.25
Primary recovery, estimated, percent	None
Present oil saturation, percent	89.0
Average porosity, percent	17.6
Oil saturation after flooding, percent	18.8
Performance factor, percent	50.0
Net floodable pay sand, feet	4.0

This core shows a thin sand section having a low oil saturation, a fair water saturation and a low permeability.

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE I-B

Company Jackson Bros. Lease Hawthorne Well No. 8

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			Ft.	Cum. Ft.			
1	2377.1	14.9	18	31	208	Imp.	0.6	0.6	125	0.00	
2	2378.1	12.3	15	51	143	Imp.	1.0	1.6	143	0.00	
3	2379.1	12.8	19	50	188	Imp.	1.0	2.6	188	0.00	
4	2380.1	13.0	21	41	212	Imp.	1.4	4.0	297	0.00	
5	2381.1	14.8	22	33	252	Imp.	0.6	4.6	151	0.00	
6	2382.1	17.6	21	30	286	1.1	1.0	5.6	286	1.10	
7	2383.1	11.7	25	36	227	Imp.	1.4	7.0	318	0.00	
8	2384.1	20.0	24	27	372	2.8	0.6	7.6	223	1.68	
9	2385.1	19.8	13	36	200	3.3	1.0	8.6	200	3.30	
10	2386.1	17.4	24	34	324	3.3	1.0	9.6	324	3.30	
11	2387.1	19.3	19	30	284	8.8	1.0	10.6	284	8.80	
12	2388.1	19.7	25	25	381	29.	1.4	12.0	533	40.60	
Total							-----		3,072		

Oilfield Research Laboratories

SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Lease	Hawthorne	Well No.
Jackson Bros.			8
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
2377.0 - 2381.6	4.6	0.0	0.00
2381.6 - 2389.0	6.0	9.8	58.78
Depth Interval, Feet	Feet of Core Analyzed	Average Percent Oil Saturation	Average Percent Water Saturation
2377.0 - 2381.6	4.6	19.0	42.8
2381.6 - 2389.0	7.4	21.8	31.3
2377.0 - 2389.0	12.0	20.7	35.7
		Average Percent Porosity	Average Oil Content Bbl./A. Ft.
2377.0 - 2381.6	4.6	13.3	196
2381.6 - 2389.0	7.4	17.6	293
2377.0 - 2389.0	12.0	15.9	256
			Total Oil Content Bbls./Acre
			904
			2,168
			3,072

Offield Research Laboratories

RESULTS OF LABORATORY TESTING

TABLE IV

Jackson Bros.

Hawthorne

Well No. 8

Sample No.	Depth, Feet	Relative Purity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc ^a	Relative Permeability Multiplier ^b	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Emb./A. Ft.	%	Emb./A. Ft.	% Oil	% Water	Emb./A. Ft.			
1	2377.1	14.5	16	180	0	0	16	36	180	0	Imp.	-
2	2378.1	12.6	13	127	0	0	13	58	127	0	Imp.	-
3	2379.1	12.5	17	165	0	0	17	47	165	0	Imp.	-
4	2380.1	12.6	19	186	0	0	19	46	186	0	Imp.	-
5	2381.1	14.3	19	211	0	0	19	37	211	0	Imp.	-
6	2382.1	17.2	18	240	0	0	18	36	240	0	Imp.	-
7	2383.1	12.0	22	205	0	0	22	42	205	0	Imp.	-
8	2384.1	19.5	22	333	0	0	22	68	333	5	0.100	50
9	2385.1	19.5	16	242	0	0	16	69	242	5	0.100	50
10	2386.1	18.0	24	335	2	28	22	63	307	6	0.100	50
11	2387.1	18.9	19	279	1	15	18	75	264	4	0.100	50
12	2388.1	19.8	25	384	8	123	17	81	261	32	0.800	30

Notes: cc—cubic centimeter.

^a—Volume of water recovered at the time of maximum oil recovery.

^b—Determined by passing water through sample which still contains residual oil.

Oilfield Research Laboratories
RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VI

Company Jackson Bros. Lease Hawthorne Well No. 8

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2377.1	159,400			
2	2378.1	145,200			
3	2379.1	136,150			
4	2380.1	138,700			
5	2381.1	166,200			
6	2382.1	149,250			
7	2383.1	162,250			
8	2384.1	132,400			
9	2385.1	116,900			
10	2386.1	146,200			
11	2387.1	141,000			
12	2388.1	178,000			

Note: ppm — parts per million