

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Jackson Bros. Lease G.K. Jackson Heirswell No. 6

Location NW SE NW

Section 23 Twp. 25S Rge. 8/E County Greenwood State Kansas

Table with 2 columns: Name of Sand, Bartlesville; Top of Core, 2359.0; Bottom of Core, 2375.7; Top of Sand, 2359.5; Bottom of Sand, 2375.0; Total Feet of Permeable Sand, 14.5; Total Feet of Floodable Sand, 12.5

Distribution of Permeable Sand: Permeability Range Millidarcys

Table with 3 columns: Permeability Range (Millidarcys), Feet, Cum. Ft. Rows: 0-5 (2.0, 2.0), 5-10 (4.1, 6.1), 10-20 (2.0, 8.1), 20-30 (2.0, 10.1), 30 & above (4.4, 14.5)

Table with 2 columns: Property Name, Value. Rows: Average Permeability Millidarcys (18.2), Average Percent Porosity (17.8), Average Percent Oil Saturation (29.2), Average Percent Water Saturation (41.7), Average Oil Content, Dbls./A. Ft. (399), Total Oil Content, Dbls./Acre (6,386), Average Percent Oil Recovery by Laboratory Flooding Tests (11.1), Average Oil Recovery by Laboratory Flooding Tests, Dbls./A. Ft. (166), Total Oil Recovery by Laboratory Flooding Tests, Dbls./Acre (1,741), Total Calculated Oil Recovery, Dbls./Acre (Primary & Secondary) (4,525), Packer Setting, Feet, Viscosity, Centipoises @, A. P. I. Gravity, degrees @ 60 °F, Elevation, Feet

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SUMMARY OF LABORATORY FLOORING TESTS

TABLE V

Company Jackson Bros.

Location G.K. Jackson Heirs

Well No. 6

Depth Interval, Feet				
Feet of Core Analyzed	2359.5 - 2362.6	2365.6 - 2475.0	2359.5 - 2475.0	
Average Percent Porosity	3.1	7.4	10.5	
Average Percent Original Oil Saturation	20.5	19.0	19.5	
Average Percent Oil Recovery	23.5	31.3	29.0	
Average Percent Residual Oil Saturation	5.2	13.6	11.1	
Average Percent Residual Water Saturation	18.3	17.7	17.9	
Average Percent Total Residual Fluid Saturation	77.2	74.8	75.5	
Average Original Oil Content, Bbls./A. Ft.	95.5	92.5	93.4	
Average Oil Recovery, Bbls./A. Ft.	375.	459.	435.	
Average Residual Oil Content, Bbls./A. Ft.	84.	200.	166.	
Total Original Oil Content, Bbls./Acre	291.	259.	269.	
Total Oil Recovery, Bbls./Acre	1,163.	3,398.	4,561.	
Total Residual Oil Content, Bbls./Acre	260.	1,481.	1,741.	
Average Effective Permeability, Millidarcys	903.	1,917.	2,820.	
Average Initial Fluid Production Pressure, p.s.i.	3.0	3.4	3.3	
	41.0	33.5	35.5	

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 G.K. Jackson Heirs Well No. 6

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
2359.0 - 2365.6	100,167		
2365.6 - 2375.0	107,904		
2359.0 - 2375.0	104,712		

Note: ppm — parts per million.

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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 by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval,</u> <u>Feet</u>	<u>Description</u>
2359.0 - 2359.5	- Hard, light brown, fine grained sandstone.
2359.5 - 2375.0	- Grayish brown, fine grained, slightly shaly sandstone.
2375.0 - 2375.7	- Black shale.

Coring was started at a depth of 2359.0 feet in hard, light brown, fine grained sandstone and completed at 2375.7 feet in black shale. This core shows a total of 16.0 feet of sandstone. For the most part, the pay is made up of grayish brown, fine grained, 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 16.0 and 19.4 millidarcys respectively; the overall average being 18.2 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 44. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly low weighted average percent oil saturation, namely, 29.2. The weighted average percent oil saturation of the upper and lower sections is 27.0 and 30.8 respectively. The weighted average percent water saturation of the upper and lower sections is 42.5 and 41.2 respectively; the overall average being 41.7 (See Table

III). This gives an overall weighted average total fluid saturation of 70.9 percent. This low total fluid saturation indicates considerable fluid was lost during coring 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 some flushing of the sand did occur during coring.

The weighted average oil content of the upper and lower sections is 347 and 428 barrels per acre foot respectively; the overall average being 399. The total oil content, as shown by this core, is 6,386 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

When taking into consideration that the sand in the core has a fairly low oil saturation, it responded very well to laboratory flooding tests, as a total recovery of 1,741 barrels of oil per acre was obtained from 10.5 feet of sand. The weighted average percent oil saturation was reduced from 29.0 to 17.9, or represents an average recovery of 11.1 percent. The weighted average effective permeability of the samples is 3.3 millidarcys, while the average initial fluid production pressure is 35.5 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 10 oil. This indicates that approximately 62 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 permeability.

CONCLUSION

From a study of the above data, it is estimated that approximately 1,850 barrels of oil per acre can be recovered from the area, represented

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by this core, by efficient primary production methods. An additional oil recovery of 2,675 barrels of oil per acre or an average of 214 barrels per acre foot can be expected by efficient water-flooding. The following data and assumptions were used in calculating the above oil recovery values:

Original formation volume factor	1.20
Irreducible water saturation, percent	34.0
Primary recovery, estimated, percent	None.
Present oil saturation, percent	57.2
Average porosity, percent	19.1
Oil saturation after flooding, percent	17.9
Performance factor, percent	55.0
Net floodable pay sand, feet	12.5

This core shows a rather clean sand section having a fairly low oil saturation, a moderate water saturation and a wide variation in permeability. No doubt considerable oil was forced out of the sand in the core by solution gas as the core was removed from the well. Of course some drilling water would replace part of the oil.

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-3

Company: Jackson Bros. Lease: G.W. Jackson Heirs Well No. 6

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. / A Ft.	Perm., ML	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
1	2359.1	7.2	40	48	88	223	Imp.	0.5	0.5	111	0.00
2	2360.1	20.7	19	41	60	305	5.0	1.1	1.6	336	5.50
3	2361.1	20.4	35	45	80	554	27.	1.0	2.6	554	27.00
4	2362.1	20.0	17	46	63	264	35.	1.0	3.6	264	35.00
5	2363.1	18.1	28	42	70	393	11.	1.0	4.6	393	11.00
6	2364.1	17.2	34	42	76	453	3.3	1.0	5.6	453	3.30
7	2365.1	13.9	23	58	81	248	Imp.	1.0	6.6	248	0.00
8	2366.1	18.0	38	41	79	530	21.	1.0	7.6	530	21.00
9	2367.1	18.5	26	41	67	373	35.	1.0	8.6	373	35.00
10	2368.1	19.8	25	47	72	383	7.9	1.0	9.6	383	7.90
11	2369.1	17.5	37	40	77	501	11.	1.0	10.6	501	11.00
12	2370.1	13.8	27	51	78	288	0.30	1.0	11.6	288	0.30
13	2371.1	14.9	31	47	78	358	9.7	1.0	12.6	358	9.70
14	2372.1	18.6	34	34	68	490	44.	1.0	13.6	490	44.00
15	2373.1	18.0	34	37	71	474	5.6	1.0	14.6	474	5.60
16	2374.1	21.5	27	35	62	450	34.	1.4	16.0	474	47.60
Total									6,386		

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Bros. Lease G.M. Jackson Heirs Well No. 6

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl/A. Ft.	Total Oil Content Bbls./Acre
2359.5 - 2364.6	5.1	16.0	81.80				347	2,359
2365.6 - 2375.0	9.4	19.4	182.10				428	4,027
2359.5 - 2375.0	14.5	18.2	263.90				399	6,386
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		
2359.0 - 2365.6	6.6	17.6	27.0	42.5	347	2,359		
2365.6 - 2375.0	9.4	18.0	30.8	41.2	428	4,027		
2359.0 - 2375.0	16.0	17.8	29.2	41.7	399	6,386		

General Research Laboratories

DEPARTMENT OF LABORATORY RECORDS

CASE 17

Jackson Bros. E. N. Jackson Heirs Wells 6

Well No.	Well Depth	Original Production		Cumulative		Residual Production			Volume of Water Recovered	Production	Total Production
		S	Days/A.Ft.	S	Days/A.Ft.	S	Days/A.Ft.	Days/A.Ft.			
1	2359.1	37	195	0	0	37	52	195	0	Imp.	50
2	2360.1	19	297	2	31	17	75	266	10	0.300	40
3	2361.1	35	565	12	194	23	76	371	116	3.10	30
4	2362.1	17	271	2	32	15	81	239	217	6.00	-
5	2363.1	26	353	0	0	26	47	353	0	Imp.	-
6	2364.1	30	407	0	0	30	49	407	0	Imp.	-
7	2365.1	21	231	0	0	21	72	231	0	Imp.	-
8	2366.1	38	519	15	205	23	73	314	13	0.300	50
9	2367.1	26	383	10	147	16	76	236	88	2.30	30
10	2368.1	25	386	10	154	15	81	232	183	4.50	30
11	2369.1	37	514	13	181	24	61	333	8	0.300	50
12	2370.1	26	284	0	0	26	70	284	9	0.300	50
13	2371.1	27	321	0	0	27	63	321	7	0.200	50
14	2372.1	34	499	19	279	15	77	220	90	1.80	30
15	2373.1	34	480	17	240	17	72	240	30	0.600	30
16	2374.1	27	440	12	196	15	81	244	233	11.00	20

Notes on this contract.

*-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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RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VI

Company Jackson Bros. Lease G.K. Jackson Heirs Well No. 6

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2359.1	169,600			
2	2360.1	90,500			
3	2361.1	66,900			
4	2362.1	75,300			
5	2363.1	109,100			
6	2364.1	113,200			
7	2365.1	112,200			
8	2366.1	108,100			
9	2367.1	122,700			
10	2368.1	69,600			
11	2369.1	124,000			
12	2370.1	135,900			
13	2371.1	118,100			
14	2372.1	129,700			
15	2373.1	122,600			
16	2374.1	59,750			

Note: ppm — parts per million