

# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

Company	<u>Jackson Brothers</u>	Lease	<u>Teichgraeber</u>	Well No. <u>8</u>
Location	<u>SE, NE, SW</u>			
Section	<u>14</u>	Twp	<u>25S</u>	Rge. <u>8E</u>
	County <u>Greenwood</u>			State <u>Kansas</u>
Name of Sand	-			Bartlesville
Top of Core	-			2340.0
Bottom of Core	-			2370.0
Pay				
Top of Sand	-			2354.4
Bottom of Sand	-			2362.5
Total Feet of Permeable Sand	-			7.6
Total Feet of Floodable Sand	-			6.6
<b>Distribution of Permeable Sand:</b>				
Permeability Range Millidarcys	Feet	Cum. Ft.		
0 - 2	1.5	1.5		
2 - 5	2.0	3.5		
5 & above	4.1	7.6		
Average Permeability Millidarcys	-			6.6
Average Percent Porosity	-			15.3
Average Percent Oil Saturation	-			26.1
Average Percent Water Saturation	-			62.2
Average Oil Content, Bbls./A. Ft.	-			322.
Total Oil Content, Bbls./Acre	-			4,119.
Average Percent Oil Recovery by Laboratory Flooding Tests	-			7.6
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	-			114.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	-			754.
Total Calculated Oil Recovery, Bbls./Acre	(Primary and Secondary)			1,590.
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	Lease	Teichgraeber	Well No.
Jackson Brothers			8
Depth Interval, Feet			2354.4 to 2362.5
Feet of Core Analyzed			6.6
Average Percent Porosity			18.9
Average Percent Original Oil Saturation			29.7
Average Percent Oil Recovery			7.6
Average Percent Residual Oil Saturation			22.1
Average Percent Residual Water Saturation			76.9
Average Percent Total Residual Fluid Saturation			99.0
Average Original Oil Content, Ebls./A. Ft.			441
Average Oil Recovery, Ebls./A. Ft.			114
Average Residual Oil Content, Ebls./A. Ft.			327
Total Original Oil Content, Ebls./Acre			2,908
Total Oil Recovery, Ebls./Acre			754
Total Residual Oil Content, Ebls./Acre			2,154
Average Effective Permeability, Millidarcys			1.28
Average Initial Fluid Production Pressure, p.s.i.			27.1

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 Brothers Lease Teichgraeber 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 &amp; Foreign Water</u>
2349.2 - 2354.4	91,904		
2354.4 - 2362.5	80,862		
2349.2 - 2362.5	85,348		

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 plastic bags by a representative of Oilfield Research Laboratories. The core was removed from the core barrel approximately 3 hours before it was sampled.

#### FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
2383.0 - 2388.0	Light brown fine grained micaceous shaly sandstone.
2388.0 - 2396.5	Light brown fine grained micaceous slightly shaly sandstone.
2396.5 - 2403.0	Dark shale.

Coring was started at a depth of 2383.0 feet in light brown fine grained micaceous shaly sandstone and completed at 2403.0 feet in dark shale. This core shows a total of 13.5 feet of sandstone. For the most part, the pay is made up of light brown fine grained micaceous 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 0.79 and 11.5 millidarcys respectively; the overall average being 7.5 (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 0.27 to a maximum of 34. millidarcys.

#### PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly low weighted average percent oil saturation, namely, 26.8. The weighted average percent oil saturation of the upper and lower sections is 28.8 and 25.8 respectively. The weighted average percent water saturation of the upper and lower sections is 52.5 and 48.6 respectively; the overall average being 50.0 (See Table III). This gives an overall weighted average total fluid saturation of 76.8 percent. This fairly low total fluid saturation indicates some 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 considerable flushing of the pay sand section (2388.0 to 2396.5) occurred during the coring operation as the chloride content of this zone is much lower than the upper section.

The weighted average oil content of the upper and lower sections is 344 and 361 barrels per acre foot respectively; the overall average being 355. The total oil content, as shown by this core, is 4,788 barrels per acre of which 3,067 barrels are in the pay sand section (See Table III).

#### LABORATORY FLOODING TESTS

The pay sand in this core responded very well to laboratory flooding tests, as a total recovery of 822 barrels of oil per acre was obtained from

8.5 feet of sand. The weighted average percent oil saturation was reduced from 25.8 to 19.0, or represents an average recovery of 6.8 percent. The weighted average effective permeability of the samples is 1.45 millidarcys, while the average initial fluid production pressure is 23.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 14 samples tested, 9 produced water and oil. This indicates that approximately 64 percent of the sand represented by these samples is floodable pay sand.

#### CONCLUSION

From a study of the above data, we estimate that approximately 2,592 barrels of oil per acre or an average of 305 barrels per acre-foot can be recovered from the area, represented by this core, by efficient primary and waterflood operations. The following data and assumptions were used in calculating the above oil recovery value:

Present formation volume factor	1.20
Irreducible water saturation, percent	30.0
Primary recovery, estimated, percent	None
Present oil saturation, percent	58.3
Average porosity, percent	18.2
Oil saturation after flooding, percent	19.0
Performance factor, percent	50.0
Net floodable pay sand, feet	8.5

This core shows a rather clean pay sand section (2388.0 to 2396.5 feet) having a fairly low oil saturation, a moderate water saturation

and fairly good porosity and permeability. No doubt, considerable flushing of the sand (in the core) occurred during the cutting of same and this could partly account for lower oil and higher water saturations.

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## SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company		Lease	Well No.	Well No.				
Jackson Brothers		Teichgraeber	8	8				
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
2349.2 - 2354.4	5.2	0.0	0.00	10.2	21.7	73.2	169	878
2354.4 - 2362.5	7.6	6.6	50.24	18.8	29.2	54.7	427	3,241
2349.2 - 2362.5	12.8			15.3	26.1	62.2	322	4,119

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers Lease Teichgraeber 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	2350.1	9.5	18	76	133	Imp.	1.4	1.4	186	0.00
2	2351.1	7.7	29	69	176	Imp.	1.0	2.4	176	0.00
3	2352.1	9.6	18	78	134	Imp.	1.0	3.4	134	0.00
4	2353.1	14.0	18	73	196	Imp.	1.0	4.4	196	0.00
5	2354.1	10.7	28	68	232	Imp.	0.8	5.2	186	0.00
6	2355.1	18.9	26	54	381	5.7	1.2	6.4	457	6.84
X7	2356.1	17.5	33	60	448	3.8	1.0	7.4	448	3.80
8	2357.1	16.8	26	63	339	1.8	1.0	8.4	339	1.80
9	2358.1	18.4	27	55	386	4.2	1.0	9.4	356	4.20
10	2359.1	20.4	21	58	333	9.9	1.0	10.4	333	9.90
11	2360.0	18.4	31	51	443	-	0.5	10.9	221	-
P-11	2360.2	-	-	-	-	1.8	0.5	11.4	-	0.90
12	2361.1	19.9	36	47	556	12.	1.9	13.3	1,057	22.80

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Teichgraeber Well No. 8

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation		Volume of Water Recovered cc <sup>s</sup>	Effective Permeability Millidarcys <sup>**</sup>	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water			
1	2350.1	9.1	20	141	0	0	20	76	0	Imp.	-
2	2351.1	8.0	26	161	0	0	26	72	0	Imp.	-
3	2352.1	9.2	17	121	0	0	17	81	0	Imp.	-
4	2353.1	13.5	20	210	0	0	20	74	0	Imp.	-
5	2354.1	11.0	25	213	0	0	25	73	0	Imp.	-
6	2355.1	19.4	26	391	4	60	22	78	30	0.60	30
7	2356.1	18.0	33	461	6	84	27	72	10	0.30	40
8	2357.1	17.1	25	332	0	0	25	74	2	0.10	50
9	2358.1	18.4	27	386	2	29	25	74	15	0.40	35
10	2359.1	20.1	21	328	3	47	18	80	120	2.80	15
11	2360.0	18.0	31	433	8	112	23	76	25	0.50	30
12	2361.1	19.7	36	551	16	245	20	79	88	2.10	20

T-8  
 Light gray marlstone into  
 normal shale up into  
 black shale

Notes: cc—cubic centimeter.

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

\*\*—Determined by constant volume shrinkage method.

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**RESULTS OF WATER DIFFERENTIATION TESTS**  
**TABLE VI**

Company Jackson Brothers Lease Teichgraeber Well No. 8

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		Total
			Connate	Drilling & Foreign	
1	2350.1	97,200			
2	2351.1	92,550			
3	2352.1	81,250			
4	2353.1	101,800			
5	2354.1	82,700			
6	2355.1	78,600			
7	2356.1	100,000			
8	2357.1	97,300			
9	2358.1	103,700			
10	2359.1	60,200			
11	2360.0	70,500			
12	2361.1	65,200			

Note: ppm -- parts per million