

# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Barrier Well No. 23

Location NW $\frac{1}{4}$

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

Name of Sand - - - - - Bartlesville

Top of Core - - - - - 2508.0

Bottom of Core - - - - - 2550.0

Pay - - - - -

Top of Sand - - - - - 2537.7

Pay - - - - -

Bottom of Sand - - - - - 2545.7

Total Feet of Permeable Sand - - - - - 8.0

Total Feet of Floodable Sand - - - - - 4.0

**Distribution of Permeable Sand:**

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 3	3.0	3.0
3 - 6	2.5	5.5
6 & above	2.5	8.0

Average Permeability Millidarcys - - - - - 4.5

Average Percent Porosity - - - - - 18.8

Average Percent Oil Saturation - - - - - 19.6

Average Percent Water Saturation - - - - - 60.7

Average Oil Content, Bbls./A. Ft. - - - - - 286.

Total Oil Content, Bbls./Acre - - - - - 2,287.

Average Percent Oil Recovery by Laboratory Flooding Tests - - - - - 5.2

Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. - - - - - 83.

Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre - - - - - 256.

Total Calculated Oil Recovery, Bbls./Acre - - - - - 1,625.

Packer Setting, Feet - - - - -

Viscosity, Centipoises @ - - - - -

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

Elevation, Feet - - - - -

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GENERAL INFORMATION & SUMMARY

Company Jackson Brothers Lease Barrier Well No. 23

Location NW 1/4

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

Name of Sand Peru
Top of Core 2365.0
Bottom of Core 2389.5
Top of Sand 2384.0
Bottom of Sand ?

Total Feet of Permeable Sand
Total Feet of Floodable Sand

Distribution of Permeable Sand:
Permeability Range Millidarcys Feet Cum. Ft.

Average Permeability Millidarcys
Average Percent Porosity 12.8
Average Percent Oil Saturation 13.6
Average Percent Water Saturation 60.4
Average Oil Content, Bbls./A. Ft. 106.
Total Oil Content, Bbls./Acre 585.
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

This well was drilled in virgin territory. A fresh water mud was used as the circulating fluid during the coring of the sand.

The Peru sand core was out of the hole for 16 hours before samples were taken. The Bartlesville sand core was out for 1½ hours before being sampled.

Both cores were sampled and the samples were sealed in plastic bags 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>	<u>PERU SAND</u>
2365.0 - 2381.0	- Shale discarded at well.	
2381.0 - 2384.0	- Sandy shale.	
2384.0 - 2384.5	- Gray shaley sandstone.	
2384.5 - 2385.5	- Gray calcareous shaley sandstone.	
2385.5 - 2389.5	- Gray laminated shaley sandstone.	
2389.5 - 2508.0	- Drilled with tools.	

#### BARTLESVILLE SAND

2508.0 - 2532.0	- Shale discarded at well.
2532.0 - 2537.7	- Gray sandy shale.
2537.7 - 2545.7	- Light brown slightly shaley sandstone.
2545.7 - 2550.0	- Black shale.

Coring of the Peru sand was started at a depth of 2365.0 feet in shale and completed at 2389.5 feet in gray laminated shaley sandstone. Coring of the Bartlesville sand was started at 2508.0 feet in shale and completed at 2550.0 feet in black shale. The cores show a total of 13.5 feet of sandstone, of which 8.0 feet is in the Bartlesville section. For the most part, the Bartlesville pay is light brown slightly shaley sandstone; while the Peru section is gray shaley

sandstone.

Porosity and oil and water saturation tests were run on the Peru sand. A complete analysis was run on the Bartlesville sand. The following discussion is concerned with the results of the complete analysis run on the Bartlesville core.

#### PERMEABILITY

The weighted average permeability of the sand in the core is 4.5 millidarcys (See Table III). By observing the data given on the coregraph, it is noticeable that the sand is tight. The permeability of the sand varies from 0.18 to a maximum of 9.8 millidarcys.

#### PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 19.6. The weighted average percent water saturation of the sand is 60.7 (See Table III). This gives an overall weighted average total fluid saturation of 80.3 percent. This total fluid saturation indicates some fluid was lost during coring, part of which probably was 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.

The weighted average oil content of the sand section is 286 barrels per acre foot and the total oil content, as shown by this core, is 2,287 barrels per acre (See Table III).

#### LABORATORY FLOODING TESTS

Part of the sand in this core reponded fairly well to laboratory flooding tests, as a total recovery of 256 barrels of oil per acre was

obtained from 3.1 feet of sand. The weighted average percent oil saturation was reduced from 17.8 to 12.6, or represents an average recovery of 5.2 percent. The weighted average effective permeability of the samples is 1.16 millidarcys, while the average initial fluid production pressure is 23.3 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 8 samples tested, 4 produced water and 3 oil. This indicates that approximately 50 percent of the sand represented by these samples will take water. The tests also show that the sand has a comparatively uniform effective permeability.

#### CONCLUSION

Efficient primary production methods should recover approximately 1,000 barrels of oil per acre from the area, of which this core is representative. An efficient water-flood within the vicinity of this well should recover an additional 625 barrels of oil per acre, or an average of 156 barrels of oil per acre foot from the 4.0 feet of floodable sand analyzed. Total oil recovery by both primary and secondary production methods should be approximately 1,625 barrels of oil per acre. The following factors and assumptions were used in calculating this recovery:

Formation volume factor	1.19
True water saturation, percent	42.0
Primary oil recovery	None
Calculated present oil saturation, percent	48.7
Porosity, percent	19.5
Oil saturation at abandonment, percent	20.0
Performance factor, percent	55.0

This core shows a thin section of pay sand that is comparatively tight. The sand has low oil and rather high water saturations. This is probably due to flushing with coring fluid, and to expansion of solution gas forcing oil from the core. The analysis results show 4.0 feet of floodable sand in the interval extending from the depth of 2537.7 to 2547.7 feet.

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**RESULTS OF PERMEABILITY TESTS**  
**TABLE I**

Company Jackson Brothers Lease Barrier Well No. 23

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
		<u>Bartlesville Sand</u>			
1	2537.9	6.8	0.5	0.5	3.40
2	2538.4	2.8	0.5	1.0	1.49
3	2538.9	4.8	0.5	1.5	2.40
4	2539.4	5.5	0.5	2.0	2.75
5	2539.9	3.9	0.5	2.5	1.95
6	2540.4	2.5	0.5	3.0	1.25
7	2540.9	0.18	0.5	3.5	0.09
8	2541.4	3.9	0.5	4.0	1.95
9	2541.9	0.70	0.5	4.5	0.35
10	2542.4	2.3	0.5	5.0	1.15
11	2542.9	4.2	0.5	5.5	2.10
12	2543.4	9.8	0.5	6.0	4.90
13	2543.9	6.6	0.5	6.5	3.30
14	2544.4	8.1	0.5	7.0	4.05
15	2544.9	6.3	0.5	7.5	3.15
16	2545.4	2.9	0.5	8.0	1.45

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RESULTS OF SATURATION TESTS

TABLE II

Company Jackson Brothers Lease Barrier Well No. 23

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.		
<u>Peru Sand</u>										
1	2384.3	7.4	23	50	73	132	0.5	0.5	66	
2	2385.3	5.1	29	55	84	115	1.0	1.5	115	
3	2386.2	14.1	12	75	87	131	1.5	3.0	196	
4	2387.7	15.0	6	51	57	70	1.0	4.0	70	
5	2388.4	16.9	7	59	66	92	1.5	5.5	138	
								Total-	-	-585
<u>Bartlesville Sand</u>										
1	2538.1	17.5	19	65	84	258	0.9	0.9	232	
2	2539.1	18.8	17	58	75	248	1.0	1.9	248	
3	2540.1	19.5	16	58	74	242	1.0	2.9	242	
4	2541.1	18.8	13	63	76	190	1.0	3.9	190	
5	2542.1	15.6	23	67	90	278	1.0	4.9	278	
6	2543.1	19.2	13	62	75	194	1.0	5.9	194	
7	2544.1	19.6	31	56	87	471	1.0	6.9	471	
8	2545.1	21.0	24	57	81	392	1.1	8.0	432	
								Total-	-	-2,287

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Brothers Lease Barrier Well No. 23

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
<u>BARTLESVILLE SAND</u>			
2537.7 - 2545.7	8.0	4.5	35.64

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
<u>PERU SAND</u>						
2384.0 - 2389.5	5.5	12.8	13.6	60.4	106	585
<u>BARTLESVILLE SAND</u>						
2537.7 - 2545.7	8.0	18.8	19.6	60.7	286	2,287

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## RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Barrier Well No. 23

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc <sup>a</sup>	Effective Permeability Millidarcys <sup>cc</sup>	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
<u>BARTLESVILLE SAND</u>												
1	2538.1	18.1	16	225	0	0	16	81	225	10	0.396	40
2	2539.1	18.6	14	202	0	0	14	75	202	0	Imp.	50+
3	2540.1	20.0	16	249	1	16	15	77	233	19	0.595	30
4	2541.1	19.1	13	193	2	30	11	77	163	47	1.50	20
5	2542.1	15.3	22	261	0	0	22	76	261	0	Imp.	50+
6	2543.1	18.8	11	161	0	0	11	73	161	0	Imp.	50+
7	2544.1	19.0	28	413	0	0	28	64	413	0	Imp.	50+
8	2545.1	20.5	24	382	12	191	12	82	191	41	1.38	20

Notes: cc—cubic centimeter.

<sup>a</sup>—Volume of water recovered at the time of maximum oil recovery.

<sup>cc</sup>—Determined by passing water through sample which still contains residual oil.

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**SUMMARY OF LABORATORY FLOODING TESTS**

**TABLE V**

<b>Company</b>	<b>Lease</b>	<b>Barrier</b>	<b>Well No.</b>
Jackson Brothers			23
<b>Depth Interval, Feet</b>	2539.6 - 2545.7		
<b>Feet of Core Analyzed</b>	3.1		
<b>Average Percent Porosity</b>	19.9		
<b>Average Percent Original Oil Saturation</b>	17.8		
<b>Average Percent Oil Recovery</b>	5.2		
<b>Average Percent Residual Oil Saturation</b>	12.6		
<b>Average Percent Residual Water Saturation</b>	78.8		
<b>Average Percent Total Residual Fluid Saturation</b>	91.4		
<b>Average Original Oil Content, Bbls./A. Ft.</b>	278.		
<b>Average Oil Recovery, Bbls./A. Ft.</b>	83.		
<b>Average Residual Oil Content, Bbls./A. Ft.</b>	195.		
<b>Total Original Oil Content, Bbls./Acre</b>	862.		
<b>Total Oil Recovery, Bbls./Acre</b>	256.		
<b>Total Residual Oil Content, Bbls./Acre</b>	606.		
<b>Average Effective Permeability, Millidarcys</b>	1.16		
<b>Average Initial Fluid Production Pressure, p.s.i.</b>	23.3		

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

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

Company Jackson Brothers Lease Barrier Well No. 23

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		Total
			Connate	Drilling & Foreign	
<u>Peru Sand</u>					
1	2384.3	157,500			
2	2385.3	168,500			
3	2386.2	101,900			
4	2387.7	154,200			
5	2388.4	135,200			
<u>Bartlesville Sand</u>					
1	2538.1	88,200			
2	2539.1	103,300			
3	2540.1	102,800			
4	2541.1	93,700			
5	2542.1	106,800			
6	2543.1	92,000			
7	2544.1	96,000			
8	2545.1	112,500			

Note: ppm -- parts per million

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Brothers Lease Barrier Well No. 23

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
<u>PERU SAND</u>			
2384.0 - 2389.5	137,650		
<u>BARTLESVILLE SAND</u>			
2537.7 - 2545.7	99,720		

Note: ppm — parts per million.