

# OILFIELD RESEARCH LABORATORIES

813 EAST SIXTH  
OKMULGEE, OKLAHOMA  
PHONE: 4444

- REGISTERED ENGINEERS -

Chanute, Kansas

536 N. HIGHLAND  
CHANUTE, KANSAS  
PHONE: 728

February 24, 1961

Mr. Gordon Willis  
319 West Seventh  
Chanute, Kansas

Dear Sir:

Enclosed herewith is the report of the analysis run on the Cable Tool core taken from the Bennett Lease, Well No. A-4, Woodson County, Kansas, and submitted to our laboratory on February 15, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES.

  
Benjamin R. Pearman

BRP:db

5 c.

# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

Company Gordon Willis Lease Bennett Well No. A-4

Location NE NE (880' S of N Line & 1100' W of E Line of Quarter Section)

Section 28 Twp. 25S Rge. 17E County Woodson State Kansas

Name of Sand	Squirrel
Top of Core	740.0
Bottom of Core	755.2
Top of Sand	745.0
Bottom of Sand	754.4
Total Feet of Permeable Sand	8.1
Total Feet of Floodable Sand	8.0

**Distribution of Permeable Sand:**

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 20	1.0	1.0
20 - 50	2.4	3.4
50 - 100	1.0	4.4
100 - 200	3.7	8.1

Average Permeability Millidarcys	75.0
Average Percent Porosity	19.9
Average Percent Oil Saturation	51.9
Average Percent Water Saturation	32.8
Average Oil Content, Bbls./A. Ft.	796.
Total Oil Content, Bbls./Acre	7,095.
Average Percent Oil Recovery by Laboratory Flooding Tests	11.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	190.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,517.
Total Calculated Oil Recovery, Bbls./Acre	1,870.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

This well was cored with a cable tool core barrel using fresh water as the coring fluid. The well was drilled in non-virgin territory. The core was sampled and the samples sealed in cans 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>
---------------------------------------	--------------------

740.0 - 745.0	- Shale discarded at well.
745.0 - 748.8	- Dark brown fine grained sandstone.
748.8 - 749.3	- Grayish light brown fine grained shaley sandstone.
749.3 - 754.4	- Dark brown fine grained sandstone.
754.4 - 755.2	- Gray sandy shale.

Coring was started at a depth of 740.0 feet in shale and completed at 755.2 feet in gray sandy shale. This core shows a total of 8.9 feet of sandstone. For the most part, the pay is made up of dark brown fine grained 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 44.8 and 96.9 millidarcys respectively; the overall average being 75.0 (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 0.91 to a maximum of 168 millidarcys.

#### PERCENT SATURATION & OIL CONTENT

The sand in this core shows a very good weighted average percent oil saturation, namely, 51.9. The weighted average percent oil saturation of the upper and lower sections is 51.6 and 52.0 respectively. The weighted average percent water saturation of the upper and lower sections is 31.2

and 34.0 respectively; the overall average being 32.8 (See Table III). This gives an overall weighted average total fluid saturation of 84.7 percent.

The weighted average oil content of the upper and lower sections is 734 and 845 barrels per acre foot respectively; the overall average being 796. The total oil content, as shown by this core, is 7,095 barrels per acre (See Table III).

#### LABORATORY FLOODING TESTS

The sand in this core responded rather well to laboratory flooding tests, as a total recovery of 1,517 barrels of oil per acre was obtained from 8.0 feet of sand. The weighted average percent oil saturation was reduced from 51.1 to 39.3, or represents an average recovery of 11.8 percent. The weighted average effective permeability of the samples is 12.46 millidarcys, while the average initial fluid production pressure is 15 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 9 samples tested, 8 produced water and 8 oil. This indicates that approximately 89 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a good permeability to water.

#### CONCLUSION

Based on the results of the laboratory tests, it appears that an efficient water-flood in the vicinity of the well should recover approximately 1,870 barrels of oil per acre. This represents an average recovery of 234 barrels of oil per acre foot from the 8.0 feet of floodable pay sand analyzed in this core.

The above recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.05
Present formation volume factor	1.02
Average water saturation, percent	30.0

OILFIELD RESEARCH LABORATORIES

-4-

Primary recovery to date, estimated, percent	7.0
Average porosity, percent	20.7
Abandonment oil saturation, percent	34.0
Performance factor, percent	55.0
Net floodable pay sand, feet	8.0

This core indicates a reservoir having a high oil saturation, a low water saturation and good permeability to water. No difficulty should be encountered in obtaining satisfactory injection rates.

**Oilfield Research Laboratories**  
**RESULTS OF PERMEABILITY TESTS**  
**TABLE I**

Company Gordon Willis Lease Bennett Well No. A-4

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	745.7	0.91	0.5	0.5	0.46
2	746.2	24.	0.5	1.0	12.00
3	746.7	37.	0.5	1.5	18.50
4	747.2	103.	0.5	2.0	51.50
5	747.7	101.	0.5	2.5	50.50
6	748.2	16.	0.5	3.0	8.00
7	748.7	29.	0.4	3.4	11.60
8	749.9	50.	0.5	3.9	25.00
9	750.4	83.	0.5	4.4	41.50
10	750.9	115.	0.5	4.9	57.50
11	751.4	68.	0.5	5.4	34.00
12	751.9	46.	0.5	5.9	23.00
13	752.4	168.	0.5	6.4	84.00
14	752.9	129.	0.5	6.9	64.50
15	753.4	104.	0.5	7.4	52.00
16	753.9	105.	0.7	8.1	73.50

**Oilfield Research Laboratories**

**RESULTS OF SATURATION TESTS**

**TABLE II**

Company Gordon Willis Lease Bennett Well No. A-4

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation		Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water		Ft.	Cum. Ft.	
1	745.4	13.1	59	29	600	0.9	0.9	540
2	746.4	19.7	47	33	717	1.0	1.9	717
3	747.4	21.8	51	31	862	1.0	2.9	862
4	748.4	19.0	50	32	737	0.9	3.8	664
5	750.2	21.4	52	35	863	1.2	5.0	1,036
6	751.2	21.1	51	34	834	1.2	6.2	1,000
7	752.2	20.5	50	35	796	1.0	7.2	1,796
8	753.2	20.9	55	31	896	1.0	8.2	896
9	754.2	20.3	53	35	834	0.7	8.9	584

# Oilfield Research Laboratories

## SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Gordon Willis Lease Bennett Well No. A-4

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.	Total Oil Content Bbls./Acre
745.0 - 748.8	3.8	18.5	51.6	31.2	44.8	152.56	2,783
749.3 - 754.4	5.1	20.9	52.0	34.0	96.9	455.00	4,312
745.0 - 754.4	8.9	19.9	51.9	32.8	75.0	607.56	7,095

Offfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

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>b</sup>	Initial Fluid Production Pressures (Lbs./Sq./In.)
			%	Eq. / A. Ft.	%	Eq. / A. Ft.	% Oil	% Water			
1	745.4	13.4	57	593	0	0	57	33	0	Imp.	50+
2	746.4	19.5	47	711	10	151	37	52	63	1.73	15
3	747.4	22.1	51	874	14	240	37	50	106	3.04	20
4	748.4	19.5	50	756	13	196	37	56	67	1.74	20
5	750.2	21.0	52	847	12	195	40	46	148	2.63	20
6	751.2	21.6	51	854	10	167	41	49	480	12.59	15
7	752.2	20.1	50	780	11	172	39	40	536	66.05	10
8	753.2	21.0	55	896	13	212	42	54	86	2.49	10
9	754.2	20.3	53	834	12	189	41	58	313	9.30	10

Company Gordon Willis

Lease Bennett

Well No. A-4

Notes: cc—cubic centimeter.

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

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

# Oilfield Research Laboratories

## SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Gordon Willis	Lease	Bennett	Well No.	A-4
Depth Interval, Feet	745.9 - 754.4				
Feet of Core Analyzed	8.0				
Average Percent Porosity	20.7				
Average Percent Original Oil Saturation	51.1				
Average Percent Oil Recovery	11.8				
Average Percent Residual Oil Saturation	39.3				
Average Percent Residual Water Saturation	50.1				
Average Percent Total Residual Fluid Saturation	89.4				
Average Original Oil Content, Bbls./A. Ft.	821.				
Average Oil Recovery, Bbls./A. Ft.	190.				
Average Residual Oil Content, Bbls./A. Ft.	631.				
Total Original Oil Content, Bbls./Acre	6,567.				
Total Oil Recovery, Bbls./Acre	1,517.				
Total Residual Oil Content, Bbls./Acre	5,050.				
Average Effective Permeability, Millidarcys	12.46				
Average Initial Fluid Production Pressure, p.s.i.	15.				

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