• CORE ANALYSIS • WATER REPRESSURING ENGINEERING • WATER ANALYSIS • FLOODING WATER TREATMENT • SURVEYING

OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

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May 14, 1959

J. H. Wagner Drilling Company
P. O. Box 751
El Dorado, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the 3½" Rotary core taken from the Booton "A" Lease, Well No. 2, Cowley County, Kansas, and submitted to our laboratory on May 8, 1959.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. McElrea

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CLM:jh

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GENERAL INFORMATION & SUMMARY

Company J. H. Wagner Drilling Co. Lease Booton "A" Well No. 2

Location SW¼, SW¼, NW¼

Section 16 Twp. 34S Rge. 3E County Cowley State Kansas

Name of Sand	Bartlesville
Top of Core	3316.0
Bottom of Core	3350.0
Pay Top of Sand (Analyzed)	3323.5
Pay Bottom of Sand (Analyzed)	3348.5
Total Feet of Permeable Sand (Analyzed)	12.0
Total Feet of Floodable Sand (Analyzed)	11.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 50	4.5	4.5
50 - 100	5.0	9.5
100 & above	2.5	12.0

Average Permeability Millidarcys	72.2
Average Percent Porosity	22.1
Average Percent Oil Saturation	12.3
Average Percent Water Saturation	59.4
Average Oil Content, Bbls./A. Ft.	204.
Total Oil Content, Bbls./Acre	2,554.
Average Percent Oil Recovery by Laboratory Flooding Tests	2.7
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	50.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	399.
Total Calculated Oil Recovery, Bbls./Acre	3,700.
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.

This core was sampled and the samples were sealed in cans by a representative of Oilfield Research Laboratories.

Depths given in this report are with respect to a point 6 feet above ground level.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
3316.0 - 3316.5	Sandy shale.
3316.5 - 3320.0	Grayish light brown fine grained slightly laminated micaceous shaley sandstone.
3320.0 - 3321.0	Grayish light brown fine grained micaceous slightly shaley sandstone.
3321.0 - 3322.0	Grayish light brown fine grained micaceous sandstone.
3322.0 - 3323.2	Grayish light brown fine grained micaceous slightly shaley sandstone.
3323.2 - 3330.0	Light brown fine grained micaceous slightly shaley sandstone.
3330.0 - 3331.0	Shale.
3331.0 - 3338.6	Light brown fine grained micaceous sandstone.
3338.6 - 3339.3	Light brown fine grained micaceous shaley sandstone.
3339.3 - 3340.0	Shale.
3340.0 - 3349.0	Light brown fine grained micaceous sandstone.
3349.0 - 3350.0	Loss.

Coring was started at a depth of 3316.0 feet in sandy shale and completed at 3350.0 feet. The core representing the interval extending from 3349.0 to 3350.0 feet was not recovered. This core shows a total of 30.8 feet of sandstone. For the most part, the pay

is made up of light brown fine grained micaceous 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 69.0 and 74.5 millidarcys respectively; the overall average being 72.2 (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 1.4 to a maximum of 226 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 12.3. The weighted average percent oil saturation of the upper and lower sections is 13.3 and 11.6 respectively. The weighted average percent water saturation of the upper and lower sections is 56.2 and 62.0 respectively; the overall average being 59.4 (See Table III). This gives an overall weighted average total fluid saturation of 71.7 percent. This low total fluid saturation indicates considerable fluid was lost during coring, part of which probably was oil.

The weighted average oil content of the upper and lower sections is 198 and 209 barrels per acre foot respectively; the overall average being 204. The total oil content, as shown by this core, is 2,554 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Part of the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 399 barrels of oil per acre was obtained from 8.0 feet of sand. The weighted average percent oil saturation was reduced from 11.8 to 9.1, or represents an

average recovery of 2.7 percent. The weighted average effective permeability of the samples is 8.04 millidarcys, while the average initial fluid production pressure is 15.6 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 13 samples tested, 11 produced water and 8 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 uniform effective permeability.

CONCLUSION

From a study of the enclosed data, we believe that efficient primary production methods will recover approximately 2,000 barrels of oil per acre from the area of which this core is representative. Efficient repressuring of the reservoir, within the vicinity of this well, should recover an additional 1,700 barrels of oil per acre, or an average of 154 barrels of oil per acre foot from the 11.0 feet of floodable pay sand analyzed. The following factors and assumptions were used in calculating these recoveries:

Formation volume factor	1.21
True water saturation, percent	43.0
Primary oil recovery	none
Calculated present oil saturation, percent	47.1
Porosity, percent	23.8
Oil saturation at abandonment	20.0
Performance factor	0.50

The results of the analysis show low oil and high water saturations for the sand in the cored section. The sand has high permeability for the depth. It is our opinion that considerable flushing of the sand

occurred during the coring and that the oil saturations are at or near residual values.

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RESULTS OF PERMEABILITY TESTS

TABLE I

Company J. H. Wagner Drilling Co. Lease Booton "A" Well No. 2

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	3316.8	Imp.	0.5	0.5	0.00
2	3317.3	Imp.	0.5	1.0	0.00
3	3321.8	5.5	0.5	1.5	2.75
4	3322.3	1.4	0.5	2.0	0.70
5	3323.8	17.	0.5	2.5	8.50
6	3324.3	14.	0.5	3.0	7.00
7	3325.8	76.	0.5	3.5	38.00
8	3326.3	221.	0.5	4.0	110.50
9	3326.8	77.	0.5	4.5	38.50
10	3327.3	19.	0.5	5.0	9.50
11	3328.8	226.	0.5	5.5	113.00
12	3329.3	33.	0.5	6.0	16.50
13	3331.8	9.7	0.5	6.5	4.85
14	3332.3	4.4	0.5	7.0	2.20
15	3333.8	81.	0.5	7.5	40.50
16	3334.3	45.	0.5	8.0	22.50
17	3335.8	79.	0.5	8.5	39.50
18	3336.3	80.	0.5	9.0	40.00
19	3340.8	103.	0.5	9.5	51.50
20	3341.3	81.	0.5	10.0	40.50
21	3342.8	91.	0.5	10.5	45.50
22	3343.3	102.	0.5	11.0	51.00
23	3344.8	77.	0.5	11.5	38.50
24	3345.3	114.	0.5	12.0	57.00
25	3347.8	89.	0.5	12.5	44.50
26	3348.3	87.	0.5	13.0	43.50

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RESULTS OF SATURATION TESTS

TABLE II

Company J. H. Wagner Drilling Co. **Lease** Booton "A" **Well No.** 2

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.	
1	3317.1	14.6	17	57	74	192	1.0	1.0	192
2	3322.1	16.7	18	55	73	233	0.5	1.5	116
3	3324.1	18.5	10	61	71	143	1.0	2.5	143
4	3326.1	24.7	11	58	69	210	1.0	3.5	210
5	3327.1	19.7	15	53	68	229	1.0	4.5	229
6	3329.1	23.5	11	53	64	200	1.0	5.5	200
7	3332.1	19.1	17	62	79	252	1.0	6.5	252
8	3334.1	23.2	11	63	74	198	1.0	7.5	198
9	3336.1	25.2	10	61	71	195	1.0	8.5	195
10	3341.1	24.0	11	61	72	204	1.0	9.5	204
11	3343.1	25.8	10	60	70	200	1.0	10.5	200
12	3345.1	25.6	14	65	79	270	1.0	11.5	270
13	3348.1	23.4	8	62	70	145	1.0	12.5	145
							Total	- - - - -	2,554

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company J. H. Wagner Drilling Co. Lease Booton "A" Well No. 2

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
3321.5 - 3329.5	5.0	69.0	344.95
3331.5 - 3348.5	7.0	74.5	521.55
3321.5 - 3348.5	12.0	72.2	866.50

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
3316.5 - 3329.5	5.5	19.9	13.3	56.2	198	1,090
3331.5 - 3348.5	7.0	23.8	11.6	62.0	209	1,464
3316.5 - 3348.5	12.5	22.1	12.3	59.4	204	2,554

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company J. H. Wagner Drilling Co. Lease Booton "A" Well No. 2

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	Effective Permeability Millidarcys**	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	3317.1	15.1	14	164	0	0	14	69	164	0	Imp.	50+
2	3322.1	16.5	16	204	0	0	16	68	204	0	Imp.	50+
3	3324.1	18.9	12	176	0	0	12	84	176	70	3.15	20
4	3326.1	25.1	11	214	3	58	8	75	156	90	15.25	15
5	3327.1	19.6	12	182	0	0	12	71	182	10	0.379	40
6	3329.1	23.0	11	196	1	18	10	83	178	129	10.16	15
7	3332.1	19.4	17	256	5	75	12	83	181	11	0.413	20
8	3334.1	23.7	11	202	1	18	10	89	184	163	8.50	15
9	3336.1	24.6	10	191	2	38	8	86	153	118	5.80	15
10	3341.1	23.6	11	201	3	55	8	85	146	114	8.12	15
11	3343.1	25.6	10	198	1	20	9	85	178	124	7.69	15
12	3345.1	25.3	14	274	6	117	8	89	157	143	8.31	15
13	3348.1	23.1	11	197	0	0	11	81	197	118	6.35	15

Notes: cc—cubic centimeter.

*—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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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company J. H. Wagner Drilling Co. Lease Booton "A" Well No. 2

Depth Interval, Feet	3325.5 - 3329.5	3331.5 - 3345.5	3325.5 - 3345.5
Feet of Core Analyzed	2.0	6.0	8.0
Average Percent Porosity	24.0	23.7	23.8
Average Percent Original Oil Saturation	11.0	12.2	11.8
Average Percent Oil Recovery	2.0	3.0	2.7
Average Percent Residual Oil Saturation	9.0	9.2	9.1
Average Percent Residual Water Saturation	79.0	86.2	84.4
Average Percent Total Residual Fluid Saturation	88.0	95.4	92.5
Average Original Oil Content, Bbls./A. Ft.	205.	220.	217.
Average Oil Recovery, Bbls./A. Ft.	38.	54.	50.
Average Residual Oil Content, Bbls./A. Ft.	167.	166.	167.
Total Original Oil Content, Bbls./Acre	410.	1,322.	1,732.
Total Oil Recovery, Bbls./Acre	76.	323.	399.
Total Residual Oil Content, Bbls./Acre	334.	999.	1,333.
Average Effective Permeability, Millidarcys	12.70	6.47	8.04
Average Initial Fluid Production Pressure, p.s.i.	15.0	15.8	15.6

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