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

OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

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June 11, 1962

William Wolfcale
Box 47
Bluffton, Indiana

Dear Sir:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Walter Grother Lease, Well No. 7, Miami County, Kansas, and submitted to our laboratory on June 6, 1962.

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

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Fred O. Stenger

Fred O. Stenger

FOS:rf

1 c. - Basil R. Smith
1 c. - Jack Nash

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GENERAL INFORMATION & SUMMARY

Company Wm. Wolfcale Lease Walter Grother Well No. 7

Location S½ SE¼

Section 18 Twp. 18S Rge. 24E County Miami State Kansas

Name of Sand	Peru
Top of Core	218.0
Bottom of Core	238.0
Top of Sand	?
Bottom of Sand (Good)	234.2
Total Feet of Permeable Sand	12.7
Total Feet of Floodable Sand	12.7

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 100	1.5	1.5
100 - 200	4.7	6.2
200 & above	6.5	12.7

Average Permeability Millidarcys	251.
Average Percent Porosity	21.4
Average Percent Oil Saturation	53.2
Average Percent Water Saturation	24.4
Average Oil Content, Bbls./A. Ft.	884.
Total Oil Content, Bbls./Acre	11,204.
Average Percent Oil Recovery by Laboratory Flooding Tests	11.7
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	206.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	2,621.
Total Calculated Oil Recovery, Bbls./Acre	2,980.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water mud was used as the circulating fluid in the coring of the sand in this well. The core was taken from a non-virgin formation.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
218.0 - 226.0	Dark brown, slightly shaly sandstone.
226.0 - 228.3	Dark brown calcareous sandstone.
228.3 - 231.2	Brownish gray, calcareous sandstone.
231.2 - 233.0	Dark brown calcareous sandstone.
233.0 - 234.2	Dark brown conglomeratic sandstone.
234.2 - 238.0	Grayish brown, calcareous, slightly shaly sandstone.

Coring was started at a depth of 218.0 feet in dark brown, slightly shaly sandstone and completed at 238.0 feet in grayish brown calcareous, slightly shaly sandstone. This core shows a total of 20.0 feet of sandstone. For the most part, the pay is made up of dark brown, slightly shaly or calcareous 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 160 and 321 millidarcys respectively; the overall average being 251(See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a good, somewhat irregular permeability profile. The permeability of the sand varies from 11. to a maximum of 514. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a very good weighted average percent oil saturation, namely, 53.2. The weighted average percent oil saturation of the upper and lower sections is 50.3 and 55.5 respectively. The

weighted average percent water saturation of the upper and lower sections is 25.7 and 23.6 respectively; the overall average being 24.4 (See Table III). This gives an overall weighted average total fluid saturation of 77.6 percent. This low total fluid saturation indicates considerable fluid was lost during coring which probably was oil.

The weighted average oil content of the upper and lower sections is 966 and 819 barrels per acre foot respectively; the overall average being 884. The total oil content, as shown by this core, is 11,204 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 2,621 barrels of oil per acre was obtained from 12.7 feet of sand. The weighted average percent oil saturation was reduced from 50.4 to 38.7, or represents an average recovery of 11.7 percent. The weighted average effective permeability of the samples is 3.72 millidarcys, while the average initial fluid production pressure is 37.4 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 14 samples tested, 13 produced water and 14 oil. This indicates that all of the sand represented by these samples is floodable pay sand. The tests also show that the sand, for the most part, has a good effective permeability and should respond favorably to water flooding.

CONCLUSION

Based on the results of the above laboratory tests and assuming an efficient water-flood operation with sufficient water pressure can be maintained within the vicinity of this well, it is believed that this well should recover approximately 2,980 barrels of oil per acre or an average of 235 barrels per acre foot from the 12.7 feet of floodable sand analyzed. In calculating this recovery the following facts and

assumptions were used:

Original formation volume factor	1.10
Present formation volume factor	1.04
Reservoir water saturation, percent	18.
Primary recovery, estimated, percent	10.
Present oil saturation, percent	65.5
Average porosity, percent	21.4
Oil saturation after flooding, percent	38.7
Performance factor, percent	50.
Net floodable pay sand, feet	12.7

This core shows a slightly shaly or calcareous sand section with a good oil saturation and, for the most part, good permeability both air and effective.

In view of the fact that the A.P.I. gravity of the oil from this well is only 20° there is some doubt as to the results which might be obtained on actual water-flooding of this sand in the field, even though laboratory results proved to be good. In other words, it is believed that the heavy oil might be by-passed by the water and result in channeling. It is further belived that good results would be obtained from the insitu-combustion method in this area where a close well spacing was used.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Wm. Wolfcale Lease Walter Grother Well No. 7

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	Total			Ft.	Cum. Ft.		
1	218.1	26.4	54	21	75	1,110	93.	0.5	0.5	555	46.50
2	219.1	22.0	47	28	75	805	11.	1.0	1.5	805	11.00
3	220.1	26.5	50	23	73	1,028	142.	1.0	2.5	1,028	142.00
4	221.1	25.4	57	18	75	1,123	229.	1.0	3.5	1,123	229.00
5	222.1	27.7	46	36	82	988	338.	1.0	4.5	988	338.00
6	223.1	21.1	50	26	76	818	116.	1.0	5.5	818	116.00
7	224.1	18.0	42	45	87	586	198.	1.0	6.5	586	198.00
8	225.1	20.4	41	35	76	649	458.	1.5	8.0	973	687.00
9	226.1	16.4	69	18	87	878	321.	0.5	8.5	439	160.50
10	227.1	16.9	53	18	71	694	148.	1.0	9.5	694	148.00
11	228.1	15.5	61	17	78	733	202.	0.8	10.3	585	161.60
12	232.1	20.1	63	12	75	982	484.	1.2	11.5	1,178	581.00
13	233.1	19.7	66	11	77	1,008	514.	0.5	12.0	504	257.00
14	234.1	23.7	72	14	86	1,325	168.	0.7	12.7	928	117.50
								Total	-------	11,204	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Wm. Wolfcale Lease Walter Grother Well No. 7

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
218.0 - 223.5	5.5	160.	882.50
223.5 - 234.2	7.2	321.	2,310.60
218.0 - 234.2	12.7	251.	3,193.10

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
218.0 - 223.5	5.5	24.7	50.3	25.7	966	5,317
223.5 - 234.2	7.2	19.0	55.5	23.6	819	5,887
218.0 - 234.2	12.7	21.4	53.2	24.4	884	11,204

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Wm. Wolfcale Lease Walter Grother Well No. 7

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	218.1	26.5	54	1,110	24	494	30	58	616	196	5.20	30
2	219.1	22.1	47	806	16	274	31	58	532	58	1.00	30
3	220.1	26.4	50	1,025	19	389	31	61	636	164	3.80	30
4	221.1	25.4	57	1.125	27	532	30	61	593	242	10.00	30
5	222.1	27.6	46	985	14	300	32	63	685	390	21.00	30
6	223.1	21.0	50	815	6	98	44	51	717	69	1.42	40
7	224.1	18.1	42	590	2	28	40	53	562	5	0.208	50
8	225.1	20.3	41	646	5	79	36	55	567	0	0.002	50
9	226.1	16.5	69	884	22	282	47	52	602	229	4.83	30
10	227.1	16.8	53	690	3	40	50	45	650	26	0.417	40
11	228.1	15.4	61	729	15	179	46	43	550	128	1.83	30
12	232.1	20.1	63	981	7	109	56	34	872	118	1.67	30
13	233.1	19.8	66	1,015	18	277	48	36	738	6	1.67	50
14	234.1	23.6	72	1,315	3	55	69	21	1,260	1	0.080	50

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 Wm. Wolfcale Lease Walter Grother Well No. 7

Depth Interval, Feet	218.0 - 223.5	223.5 - 234.2	218.0 - 234.2
Feet of Core Analyzed	5.5	7.2	12.7
Average Percent Porosity	24.7	19.0	21.4
Average Percent Original Oil Saturation	50.4	50.4	50.4
Average Percent Oil Recovery	17.1	7.6	11.7
Average Percent Residual Oil Saturation	33.3	42.8	38.7
Average Percent Residual Water Saturation	58.8	43.7	50.2
Average Percent Total Residual Fluid Saturation	92.1	86.5	88.9
Average Original Oil Content, Bbls./A. Ft.	966.	819.	880.
Average Oil Recovery, Bbls./A. Ft.	335.	109.	206.
Average Residual Oil Content, Bbls./A. Ft.	631.	710.	674.
Total Original Oil Content, Bbls./Acre	5,311.	5,885.	11,196.
Total Oil Recovery, Bbls./Acre	1,840.	781.	2,621.
Total Residual Oil Content, Bbls./Acre	3,471.	5,104.	8,575.
Average Effective Permeability, Millidarcys	7.24	1.03	3.72
Average Initial Fluid Production Pressure, p.s.i.	31.8	41.7	37.4

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