

OILFIELD RESEARCH LABORATORIES

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February 16, 1959

National Associated Petroleum Company
P. O. Box 128
Wellsville, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the 1 $\frac{1}{4}$ " Rotary core taken from the Ackley Lease, Well No. 9-W5, Franklin County, Kansas, and submitted to our laboratory on February 8, 1959, by Mr. J. R. March.

This core was sampled and the samples sealed in cans by a representative of the client.

Your business is greatly appreciated.

Very truly yours,

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Carl L. Pate

CLP:cs

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GENERAL INFORMATION & SUMMARY

Company National Associated Petroleum Co. Lease Ackley Well No. 9-W5
Location SW $\frac{1}{4}$
Section 3 Twp. 16S Rge. 21E County Franklin State Kansas
Name of Sand - - - - - Squirrel
Top of Core - - - - - 681.0
Bottom of Core - - - - - 712.0
Top of Sand - - - - - (Received) 681.0
Pay
Bottom of Sand - - - - - 705.0
Total Feet of Permeable Sand - - - - - 17.1
Total Feet of Floodable Sand - - - - - 13.0

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

0 - 10 1.5 1.5
10 - 20 4.0 5.5
20 - 40 7.0 12.5
40 & above 4.6 17.1

Average Permeability Millidarcys - - - - - 34.1
Average Percent Porosity - - - - - 18.0
Average Percent Oil Saturation - - - - - 44.8
Average Percent Water Saturation - - - - - 32.1
Average Oil Content, Bbls./A. Ft. - - - - - 647.
Total Oil Content, Bbls./Acre - - - - - 14,560.
Average Percent Oil Recovery by Laboratory Flooding Tests - - - - - 16.4
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. - - - - - 272.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre - - - - - 3,695.
Total Calculated Oil Recovery, Bbls./Acre - - - - - 5,450.
Packer Setting, Feet - - - - -
Viscosity, Centipoises @ - - - - -
A. P. I. Gravity, degrees @ 60 °F - - - - -
Elevation, Feet - - - - -

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.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
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681.0 - 681.6	Brown slightly shaley sandstone.
681.6 - 683.5	Laminated sandstone and shale.
683.5 - 687.0	Gray sandy limestone containing a vertical fracture.
687.0 - 689.0	Brown sandstone.
689.0 - 691.0	Core not received.
691.0 - 705.0	Dark brown sandstone.
705.0 - 706.0	Dark carbonaceous sandstone.
706.0 - 712.0	Gray shale.

Coring was started at a depth of 681.0 feet in brown slightly shaley sandstone and completed at 712.0 feet in gray shale. This core shows a total of 17.6 feet of sandstone. For the most part, the pay is made up of brown to dark brown sandstone. Samples representing the core, extending from a depth of 689.0 to 691.0 feet, were not submitted to our laboratory.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 45.8, 39.6 and 21.8 millidarcys respectively; the overall average being 34.1 (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 4.0 to a maximum of 92 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 44.8. The weighted average percent oil saturation of the upper, middle and lower sections is 38.6, 46.7 and 49.9 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 41.5, 26.4 and 30.7 respectively; the overall average being 32.1 (See Table III). This gives an overall weighted average total fluid saturation of 76.9 percent.

The weighted average oil content of the upper, middle and lower sections is 355, 778 and 816 barrels per acre foot respectively; the overall average being 647. The total oil content, as shown by this core, is 14,560 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The pay sand in this core responded very well to laboratory flooding tests, as a total recovery of 1,658 barrels of oil per acre was obtained from 13.6 feet of sand. The weighted average percent oil saturation was reduced from 44.8 to 16.4, or recovered an average recovery of 16.4 percent. The weighted average effective permeability of the samples is 3.23 millidarcys, while the average initial fluid production pressure is 22.0 pounds per square inch (See Table V).

By observing the data given in Table IV, and the data that of the 22 samples tested, 15 produced water and 14 oil. This indicates that approximately 64 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a rather wide variation in effective permeability.

CONCLUSION

On the basis of the above data, it is evident that approximately 1,650 barrels of oil per acre can be recovered, from the area represented

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by this core, by efficient primary production methods. An additional oil recovery of approximately 3,800 barrels per acre or an average of 292 barrels per acre foot can be expected by efficient water-repressuring. In calculating the above oil recovery values, the following factors and assumptions were employed:

Original formation volume factor	1.06
Present formation volume factor	1.03
Irreducible water saturation, percent	27.0
Primary oil recovery	None
Present oil saturation, percent	70.9
Oil saturation at abandonment, percent	30.0
Percent porosity	21.2
Net feet of floodable pay sand	13.0
Performance factor (permeability distribution and sweep efficiency)	0.56

This core shows a clean pay sand section (687.0 to 705.0 feet) having a good oil saturation, a low water saturation and fairly good permeability.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

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.		
F-1	681.5	21.9	41	-	697	54.	0.0	0.0	418	32.40
1	681.7	14.1	27	53	296	-	0.5	1.1	148	-
2	682.5	14.5	43	46	484	Imp.	0.9	2.0	436	0.00
3	683.4	15.7	44	42	536	-	0.5	2.5	268	-
F-3	683.6	-	-	-	-	Imp.	0.5	3.0	-	0.00
4	684.5	2.7	27	64	57	Imp.	1.0	4.0	57	0.00
5	685.5	3.3	38	36	97	Imp.	1.0	5.0	97	0.00
6	686.5	3.4	44	41	116	Imp.	1.0	6.0	116	0.00
7	687.5	17.8	48	22	663	62.	1.0	7.0	663	62.00
8	688.4	19.8	35	28	538	-	0.5	7.5	269	-
F-8	688.6	14.7	33	-	376	3.6	0.5	8.0	188	1.80
9	691.5	22.2	48	24	827	92.	1.0	9.0	827	92.00
10	692.5	23.2	49	21	882	39.	1.0	10.0	882	39.00
11	693.5	23.6	48	22	879	47.	1.0	11.0	879	47.00
12	694.5	22.5	48	21	838	39.	1.0	12.0	838	39.00
13	695.5	18.4	48	35	686	17.	1.0	13.0	686	17.00
14	696.5	20.4	42	32	663	24.	1.0	14.0	663	24.00
15	697.5	20.7	44	28	707	33.	1.0	15.0	707	33.00
16	698.5	21.1	45	28	737	28.	1.0	16.0	737	28.00
17	699.5	21.0	48	27	782	37.	1.0	17.0	782	37.00
18	700.5	19.4	48	36	722	4.0	1.0	18.0	722	4.00
19	701.5	20.8	44	35	710	15.	1.0	19.0	710	15.00
20	702.5	21.9	50	33	850	22.	1.0	20.0	850	22.00
21	703.5	19.9	44	35	680	13.	1.0	21.0	680	13.00
22	704.5	23.2	49	30	882	64.	1.0	22.0	882	64.00
23	705.5	21.2	64	15	2,053	13.	1.0	23.0	1,053	13.00
							Total	-	14,560	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	National Associated Petroleum Co.		Lease	Ackley		Well No.	9-W5
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.				
681.0 - 689.0	2.1	45.8	96.20				
691.0 - 700.0	9.0	39.6	336.00				
700.0 - 706.0	6.0	21.8	131.00				
681.0 - 689.0	17.1	34.1	583.20				
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	
681.0 - 689.0	7.5	11.4	38.6	41.5	355	2,660	
691.0 - 700.0	9.0	21.4	46.7	26.4	778	7,003	
700.0 - 706.0	6.0	21.1	49.9	30.7	816	4,897	
681.0 - 706.0	22.5	18.0	44.8	32.1	647	14,560	

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company		National Associated Petroleum Co.		Lease		Ackley		Well No.		9-W5	
Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation		Volume of Water Recovered cc ^a	Effective Permeability Millidarcys ^{aa}	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water			
1	681.5	21.9	41	697.	15	255	26	67	64	11.07	20
2	682.5	14.9	40	462	0	0	40	54	0	Imp.	50+
4	684.5	3.3	30	77	0	0	30	63	0	Imp.	50+
5	685.5	3.3	34	87	0	0	34	42	0	Imp.	50+
6	686.5	3.8	46	136	0	0	46	42	0	Imp.	50+
7	687.5	18.3	48	681	21	298	27	64	180	6.93	15
8	688.6	14.7	33	376	0	0	33	57	0	Imp.	50+
9	691.5	22.4	48	834	22	382	26	68	63	4.41	15
10	692.5	22.9	49	870	24	426	25	64	87	4.60	20
11	693.5	23.2	48	864	23	414	25	65	110	3.46	15
12	694.5	23.0	48	856	22	393	26	62	73	9.32	15
13	695.5	18.6	48	693	16	231	32	66	25	0.591	30
14	696.5	20.8	42	678	14	226	28	65	54	1.65	20
15	697.5	20.4	44	696	15	237	29	63	39	1.48	20
16	698.5	21.3	45	744	9	149	36	56	100	2.15	20
17	699.5	20.7	48	771	14	225	34	59	69	2.27	20
18	700.5	19.7	48	734	9	138	39	51	16	0.408	25
19	701.5	20.2	42	658	0	0	42	50	4	0.203	45
20	702.5	21.4	47	780	0	0	47	40	0	Imp.	50+
21	703.5	19.5	44	666	7	106	37	59	14	0.230	30
22	704.5	22.7	49	863	18	317	31	60	91	3.04	20
23	705.5	21.2	60	987	0	0	60	20	0	Imp.	50+

Notes: cc—cubic centimeter.

^a—Volume of water recovered at the time of maximum oil recovery.

^{aa}—Determined by passing water through sample which still contains residual oil.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	National Associated Petroleum Co.		Lease	Ackley	Well No. 9-W5	
Depth Interval, Feet	681.0 - 688.0		691.0 - 700.0	700.0 - 705.0	681.0 - 705.0	
Feet of Core Analyzed	1.6		9.0	3.0	13.6	
Average Percent Porosity	19.6		21.5	20.6	21.2	
Average Percent Original Oil Saturation	44.6		46.7	47.0	46.6	
Average Percent Oil Recovery	18.0		17.7	15.3	16.4	
Average Percent Residual Oil Saturation	26.6		29.0	35.7	30.2	
Average Percent Residual Water Saturation	65.0		62.3	56.7	61.6	
Average Percent Total Residual Fluid Saturation	91.6		91.3	92.4	91.8	
Average Original Oil Content, Bbls./A. Ft.	687.		778.	754.	763.	
Average Oil Recovery, Bbls./A. Ft.	282.		298.	187.	272.	
Average Residual Oil Content, Bbls./A. Ft.	405.		480.	567.	491.	
Total Original Oil Content, Bbls./Acre	1,099.		7,006.	2,263.	10,368.	
Total Oil Recovery, Bbls./Acre	451.		2,683.	561.	3,695.	
Total Residual Oil Content, Bbls./Acre	648.		4,323.	1,702.	6,673.	
Average Effective Permeability, Millidarcys	8.30		2.99	1.23	3.23	
Average Initial Fluid Production Pressure, p.s.i.	17.5		19.4	30.0	22.0	

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