

OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

January 10, 1951

Berry & Eells
P. O. Box 206
Newton, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Cable tool core taken from the Reinhardt & Malson Lease, Well No. 21, Neosho County, Kansas, and submitted to our laboratory on December 8, 1950.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:mm

c.c. to Mr. L. C. McLaughlin

28-27-19E

REINHARDT & MASON 21

BERRY & EELLS

CORE ANALYSIS REPORT

REINHARDT & MALSON LEASE WELL NO. 21

NEOSHO COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

JANUARY 10, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

Location _____

Section 28 Twp. 27S Rge. 19E County Neosho State Kansas

Name of Sand		Bartlesville
Top of Core		688.00
Bottom of Core		712.30
Top of ^{Pay} / _{Sand}		693.70
Bottom of ^{Pay} / _{Sand}		706.25
Total Feet of Permeable Sand		11.60
Distribution of Permeable Sand:		
Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 50	1.78	1.78
50 - 150	3.85	5.63
150 - 200	0.60	6.23
200 - 250	2.37	8.60
250 - 300	1.30	9.90
300 - 350	0.90	10.80
350 & above	0.80	11.60
Average Permeability Millidarcys		173.91
Average Percent Porosity		20.85
Average Percent Oil Saturation		54.13
Average Percent Water Saturation		34.85
Average Oil Content, Bbls./A. Ft.		875.
Total Oil Content, Bbls./Acre		10,279.
Average Percent Oil Recovery by Laboratory Flooding Tests		27.49
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.		443.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre		5,135.
Total Calculated Oil Recovery, Bbls./Acre		4,550.
Packer Setting, Feet		694.50
Viscosity, Centipoises @		
A. P. I. Gravity, degrees @ 60 °F		

The above averages are for that part of the cored section extending from the packer setting to the top of the cement plug.

Fresh water was used as a circulating fluid in the coring of the sand in this well.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval,</u> <u>Feet</u>	<u>Description</u>
688.00 - 688.70	- Gray shale.
688.70 - 689.00	- Gray sandy shale.
689.00 - 689.45	- Laminated sandy shale.
689.45 - 693.55	- Light brown fine grained micaceous sandstone containing two shale breaks.
693.55 - 693.70	- Gray shale.
693.70 - 694.00	- Brown fine grained micaceous sandstone.
694.00 - 694.35	- Gray shale.
694.35 - 695.35	- Dark brown fine grained micaceous sandstone.
695.35 - 695.45	- Finely laminated carbonaceous sandstone.
695.45 - 695.55	- Laminated shaley sandstone.
695.55 - 695.65	- Laminated sandy shale.
695.65 - 698.50	- Brown fine grained micaceous sandstone.
698.50 - 701.55	- Dark brown fine grained micaceous sandstone.
701.55 - 702.37	- Dark brown fine grained micaceous slightly conglomeratic sandstone.
702.37 - 704.20	- Brown fine grained micaceous sandstone.
704.20 - 704.35	- Hard sandy shale.
704.35 - 704.50	- Brown fine grained micaceous sandstone.
704.50 - 704.60	- Gray shale.

- 704.60 - 704.80 - Brown fine grained laminated micaceous carbonaceous sandstone.
- 704.80 - 706.25 - Brown fine grained micaceous sandstone.
- 706.25 - 707.05 - Dark brown fine grained micaceous carbonaceous sandstone.
- 707.05 - 709.05 - Gray shale.
- 709.05 - 712.30 - According to log, gray shale (discarded at well).

Coring was started at a depth of 688.00 feet in gray shale and completed at 712.30 feet in gray shale. This core shows a total of 14.8 feet of sandstone. For the most part, the pay sand is made up of 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 are 137.24 and 172.83 millidarcys respectively while that of the pay sand, or that part of the cored section extending from the packer setting to the top of the cement plug, is 173.91 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand has a fairly irregular permeability profile. The sand also contains four loose streaks.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core shows a very good weighted average percent oil saturation, namely, 54.13. The weighted average percent oil saturation of the upper and lower sections are 24.00 and 54.07 respectively. The weighted average percent water saturation of the upper and lower sections are 50.83 and 34.90 respectively while that of the pay sand is 34.85 (See Table IV). This gives an overall weighted average

total fluid saturation of 88.98 percent.

In order 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 VII and VIII. Inasmuch as the zones of higher permeability do not necessarily have the lower chloride content, it is evident that very little flushing of the sand did occur during coring. The comparatively low water saturation of the sand also bears this out.

The weighted average oil content of the upper and lower sections are 362 and 873 barrels per acre foot while that of the pay sand is 875. The total oil content, as shown by this core, is 11,396 barrels per acre of which 10,379 barrels are in the pay sand section (See Table IV).

LABORATORY FLOODING TESTS

The pay sand in this core responded very well to laboratory flooding tests as a total recovery of 5,135 barrels of oil per acre was obtained from 11.60 feet of sand. The weighted average percent oil saturation was reduced from 54.15 to 26.66, or represents an average recovery of 27.49 percent. The weighted average effective permeability of the samples is 10.1 millidarcys while the average initial fluid production pressure is 8.9 pounds per square inch (See Table VI).

From the data given in Table V, you will note that of the 12 samples tested, all produced water and 10 oil. These tests show that practically all of the pay sand is floodable. The tests also show that the sand does not have as wide variation in effective permeability as it does in air permeability. The intermediate zone located above the pay is very loose and would take water very freely if exposed to same.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 4,550 barrels of oil per acre or an average of 419 barrels per acre foot. In calculating this recovery, no allowance was made for oil lost during coring.

This core shows a total of 10.85 feet of good floodable sand. Inasmuch as the intermediate zone above the pay has a rather high permeability, it was recommended that the packer be set at a depth of 694.50 feet in order to shut off this zone. Because of the comparatively high effective permeability of the sand, we did not think it necessary to shoot the sand in this well as it should take sufficient water without shooting.

Oil Field Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	689.55	1.3	0.30	0.30	0.39
2	690.05	24.	0.70	1.00	16.80
3	690.70	30.	0.55	1.55	16.50
4	691.45	237.	0.60	2.15	142.20
5	692.10	350.	0.40	2.55	140.00
6	692.35	205.	0.30	2.85	61.50
7	692.65	241.	0.35	3.20	84.35
8	693.05	133.	0.35	3.55	46.55
9	693.40	77.	0.35	3.90	26.95
10	694.45	74.	0.25	4.15	18.50
11	694.75	87.	0.35	4.50	30.55
12	695.15	28.	0.40	4.90	11.20
13	695.68	5.2	0.15	5.05	0.78
14	695.90	142.	0.30	5.35	42.60
15	696.30	245.	0.40	5.75	98.00
16	696.70	122.	0.40	6.15	48.80
17	697.20	131.	0.60	6.75	78.60
18	697.80	153.	0.60	7.35	91.80
19	698.33	242.	0.40	7.75	96.80
20	698.65	148.	0.40	8.15	59.20
21	699.18	111.	0.50	8.65	55.00
22	699.62	325.	0.40	9.05	130.00
23	699.95	285.	0.35	9.40	99.75
24	700.35	230.	0.35	9.75	80.50
25	700.70	91.	0.40	10.15	36.40
26	701.20	67.	0.65	10.80	43.55
27	701.60	376.	0.35	11.15	131.60
28	702.20	201.	0.47	11.62	94.47
29	702.60	3.5	0.53	12.15	11.86
30	703.30	256.	0.60	12.75	153.60
31	703.75	41.	0.45	13.20	18.45
32	704.15	45.	0.25	13.45	11.25
33	704.80	76.	0.15	13.60	11.40
34	705.12	252.	0.35	13.95	88.20
35	705.60	317.	0.50	14.45	158.50
36	706.05	368.	0.45	14.90	165.60
37	706.40	248.	0.25	15.15	62.00
38	706.70	219.	0.55	15.70	120.45

Oil Field Research Laboratories
SUMMARY OF PERMEABILITY TESTS

TABLE II

Company	Berry & Eells	Lease	Reinhardt & Malson	Well No.	21
Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.		
689.45 - 693.55	3.90	137.24	535.24		
694.35 - 707.05	11.80	172.83	2039.41		
694.50 - 707.00	11.60	173.91	2017.36		

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RESULTS OF SATURATION TESTS

TABLE III

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

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	691.92	20.5	22.2	48.0	70.2	356	1.20	1.20	426
2	692.92	18.6	23.5	55.1	78.6	339	1.15	2.35	390
3	693.92	18.5	33.4	45.7	79.1	480	0.30	2.65	144
4	695.03	19.7	50.4	35.3	85.7	770	1.00	3.65	770
F5	696.05	20.4	49.6	-	-	785	1.15	4.80	901
6	697.63	20.1	53.8	29.4	83.2	840	1.70	6.50	1,430
7	698.95	19.6	57.9	30.7	88.6	882	1.10	7.60	970
8	700.22	19.9	57.7	32.4	90.1	892	1.20	8.80	1,070
9	701.45	22.6	56.7	34.3	91.0	994	1.57	10.37	1,560
10	702.93	20.0	56.4	38.2	94.6	875	1.83	12.20	1,600
11	704.42	25.3	23.5	40.6	64.1	462	0.15	12.35	69
12	705.93	22.8	54.1	38.3	92.4	956	1.45	13.80	1,389
13	706.96	21.8	50.0	41.7	91.7	846	0.80	14.60	677
							Total	- - - -	11,396

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
691.20-694.00	2.65	19.47	24.00	50.83	362	960
694.35-707.05	11.95	20.85	54.07	34.90	873	10,436
694.50-707.00	11.75	20.86	54.13	34.85	875	10,279

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RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

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.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	691.77	20.4	21.5	340	0.0	0	21.5	68.5	340	124	12.50	5
2	692.77	18.8	22.2	324	0.0	0	22.2	59.7	324	115	10.90	10
3	693.75	19.8	31.0	477	11.5	177	19.5	64.9	300	162	7.22	15
4	694.87	20.1	49.9	778	28.2	440	21.7	70.5	338	146	6.88	5
5	696.05	20.4	49.6	785	22.2	351	27.4	63.4	434	108	9.73	10
6	697.47	20.1	53.2	830	28.9	451	24.3	66.0	379	109	7.06	5
7	698.82	19.4	57.6	867	30.4	458	27.2	62.2	409	139	6.52	5
8	700.07	20.1	56.4	881	36.6	572	19.8	57.8	309	158	11.15	5
9	701.34	22.1	57.6	988	30.0	515	27.6	63.0	473	212	81.72	5
10	702.82	20.0	55.4	860	29.8	463	25.6	72.9	397	225	6.20	10
12	705.77	23.3	53.1	960	26.7	483	26.4	52.2	477	90	15.18	5
13	706.82	21.6	51.2	859	3.4	57	47.8	33.9	802	12	0.300	30

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 VI

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

Depth Interval, Feet	693.70 - 707.05	694.50 - 707.00
Feet of Core Analyzed	12.10	11.60
Average Percent Porosity	20.79	20.82
Average Percent Original Oil Saturation	53.51	54.15
Average Percent Oil Recovery	27.00	27.49
Average Percent Residual Oil Saturation	26.51	26.66
Average Percent Residual Water Saturation	61.85	61.76
Average Percent Total Residual Fluid Saturation	88.36	88.42
Average Original Oil Content, Bbls./A. Ft.	863.	875.
Average Oil Recovery, Bbls./A. Ft.	434.	443.
Average Residual Oil Content, Bbls./A. Ft.	429.	432.
Total Original Oil Content, Bbls./Acre	10,452.	10,150.
Total Oil Recovery, Bbls./Acre	5,257.	5,135.
Total Residual Oil Content, Bbls./Acre	5,195.	5,015.
Average Effective Permeability, Millidarcys	9.95	10.10
Average Initial Fluid Production Pressure, p.s.i.	9.5	8.9

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

Oil Field Research Laboratories
RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VII

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation	
			Connate	Drilling & Foreign
			Total	
1	691.92	16,100		
2	692.92	19,800		
3	693.92	15,600		
4	695.03	17,600		
6	697.63	19,800		
7	698.95	20,200		
8	700.22	21,500		
9	701.45	15,800		
10	702.93	17,500		
11	704.42	13,200		
12	705.93	12,800		
13	706.96	17,800		

Note: ppm - parts per million

Oil Field Research Laboratories
SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Berry & Eells Lease Reinhardt & Malson Well No. 21

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
691.20 - 694.00	17,649		
694.35 - 707.05	17,674		
694.50 - 707.00	17,683		

Note: ppm - parts per million