OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

January 20, 1951

Deep Rock Oil Corporation
Atlas Life Building
Tulsa, Oklahoma

Attention: Mr. T. F. Lawry

Gentlemen:

Enclosed herewith is the report of the analysis of the Cable Tool core taken from the Main Lease, Well No. ML-24, Crawford County, Kansas, and submitted to our laboratory on January 6, 1951.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:sam

c.c. to Mr. Neil Henderson
Mr. Jack West

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Deep Rock Oil Corporation Lease Mein Well No. ML-24

Location NW¼

Section 27 Twp. 28S Rge. 22E County Crawford State Kansas

Name of Sand	Bartlesville
Top of Core	370.00
Bottom of Core	393.56
Top of Sand	380.55
Bottom of Sand	390.30
Total Feet of Permeable Sand	8.85

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 25	3.00	3.00
25 - 50	2.20	5.20
50 - 75	2.05	7.25
75 - 100	1.00	8.25
100 & above	0.60	8.85

Average Permeability Millidarcys	48.18
Average Percent Porosity	19.89
Average Percent Oil Saturation	38.77
Average Percent Water Saturation	42.45
Average Oil Content, Bbls./A. Ft.	600.
Total Oil Content, Bbls./Acre	5,250.
Average Percent Oil Recovery by Laboratory Flooding Tests	10.04
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	158.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	870.
Total Calculated Oil Recovery, Bbls./Acre	3,000.
Packer Setting, Feet	381.00
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:

Depth Interval, Feet	Description
370.00 - 371.28	Light brown fine grained micaceous sandstone.
371.28 - 371.55	Gray sandy shale.
371.55 - 373.80	Light brown fine grained micaceous sandstone.
373.80 - 373.90	Gray shale.
373.90 - 374.65	Light brown fine grained micaceous shaley sandstone.
374.65 - 375.28	Alternate layers of soft gray shale and sandstone.
375.28 - 375.60	Brown fine grained micaceous shaley sandstone.
375.60 - 377.40	Light brown fine grained micaceous sandstone.
377.40 - 377.67	Gray shale.
377.67 - 378.25	Light brown fine grained micaceous sandstone.
378.25 - 378.50	Laminated sandstone and shale.
378.50 - 380.55	Light brown fine grained micaceous sandstone.
380.55 - 381.15	Brown fine grained micaceous sandstone.
381.15 - 381.40	Light brown fine grained micaceous sandstone.
381.40 - 387.10	Brown fine grained micaceous sandstone.
387.10 - 390.30	Brown fine grained slightly laminated micaceous shaley sandstone.
390.30 - 393.56	Dark fine grained finely laminated micaceous carbonaceous shaley sandstone.

Coring was started at a depth of 370.00 feet in fine grained micaceous sandstone and completed at 393.56 feet in dark fine grained finely laminated micaceous carbonaceous shaley sandstone. This core shows a total of 21.48 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 three sections. The weighted average permeability of the upper, middle and lower sections are 22.69, 62.27 and 38.63 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 48.18 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand section has a very irregular permeability profile. The sand in this core has a higher average permeability than the cores taken on the Engel Lease and analyzed by us.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core shows a fairly good weighted average percent oil saturation, namely, 38.77. The weighted average percent oil saturation of the upper, middle and lower sections are 26.50, 41.06 and 37.73 respectively. The weighted average percent water saturation of the upper, middle and lower sections are 41.88, 39.26 and 45.95 respectively while that of the pay sand is 42.45 (See Table IV). This gives an overall weighted average total fluid saturation of 81.22 percent. This comparatively low total fluid saturation indicates that an appreciable amount of fluid was lost during coring which was probably oil. By observing the above data and that given on the coregraph, it is

evident that the upper part of the cored section is apparently an intermediate zone containing very little recoverable oil.

In an effort 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. From the data given in these tables and on the coregraph, it is evident that some flushing of the sand did occur during coring; however, we are of the opinion that most of the oil lost during the coring operation was due to the expansion of gas carried in solution by the oil.

The weighted average oil content of the upper, middle and lower sections are 401, 552, and 578 barrels per acre foot respectively while that of the pay sand is 600. The total oil content, as shown by this core, is 11,136 barrels per acre of which 5,250 barrels are in the pay sand section (See Table IV).

LABORATORY FLOODING TESTS

The pay sand in this core responded fairly well to laboratory flooding tests as a total recovery of 870 barrels of oil per acre was obtained from 5.50 feet of sand. The weighted average percent oil saturation was reduced from 40.04 to 30.00, or represents an average recovery of 10.04 percent. The weighted average effective permeability of the samples is 3.39 millidarcys while the average initial fluid production pressure is 16.5 pounds per square inch (See Table VI). The above tests show that the sand samples after flooding have a rather high percent residual oil saturation.

By observing the data given in Table V, you will note that of the

17 samples tested, 15 produced water and 11 oil. This indicates that only part of the sand contains recoverable oil. The tests also show that the pay sand or the lower part of the cored section has a fairly uniform effective permeability.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 3,000 barrels of oil per acre or an average of 413 barrels per acre foot from the 7.25 feet of good floodable sand. In calculating this recovery, an allowance was made for oil lost during coring and it was assumed that that the true water saturation of the sand is 34 percent and that the well was drilled in virgin territory.

The principle drawback of this core is the fact that it has a fairly thin pay sand section, however, the sand has a higher permeability than the other cores taken in this area and analyzed by us.

Oil Field Research Laboratories

SHOT RECOMMENDATION

Company Deep Rock Oil Corporation Lease Hein Well No. H-24

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
385.0 - 389.0	4.0	4½	3.1	12.4

Recommended Packer Setting 381.0 feet.
Note: Plug hole back to 390.0 feet.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Hein Well No. K1-24

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	370.32	20.	0.50	0.50	10.00
2	370.75	21.	0.40	0.90	8.40
3	371.06	24.	0.38	1.28	9.12
4	371.64	3.7	0.35	1.63	1.30
5	372.10	9.1	0.40	2.03	3.64
6	372.47	21.	0.50	2.53	10.50
7	373.10	21.	0.40	2.93	8.40
8	373.36	27.	0.30	3.23	8.10
9	373.70	13.	0.30	3.53	3.90
10	374.20	6.5	0.50	4.03	3.25
11	374.63	2.9	0.25	4.28	0.73
12	375.40	2.9	0.32	4.60	0.93
13	375.70	7.5	0.25	4.85	1.88
14	376.02	17.	0.35	5.20	5.95
15	376.40	9.3	0.40	5.60	3.72
16	376.70	22.	0.15	5.75	3.30
17	376.83	18.	0.25	6.00	4.50
18	377.23	19.	0.40	6.40	7.60
19	377.75	20.	0.33	6.73	6.60
20	378.20	27.	0.25	6.98	6.75
21	378.70	44.	0.40	7.38	17.60
22	379.05	88.	0.40	7.78	35.20
23	379.55	61.	0.45	8.23	27.45
24	379.95	33.	0.45	8.68	14.85
25	380.53	3.6	0.35	9.03	1.26
26	381.35	52.	0.25	9.28	13.00
27	381.78	47.	0.60	9.88	28.20
28	382.50	47.	0.60	10.48	28.20
29	382.66	51.	0.30	10.78	15.30
30	383.15	22.	0.40	11.18	8.80
31	383.65	35.	0.70	11.88	24.50
32	384.42	59.	0.70	12.58	41.30
33	384.93	79.	0.50	13.08	39.50
34	385.46	89.	0.50	13.58	44.50
35	385.97	144.	0.60	14.18	86.40
36	386.60	51.	0.80	14.98	40.80
37	387.32	14.	0.55	15.53	7.70
38	387.90	11.	0.35	15.86	3.85
39	388.25	14.	0.70	16.58	9.80
40	389.05	17.	0.55	17.13	9.35

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RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Hein Well No. HI-24

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	389.40	24.	0.45	17.58	10.80
42	390.05	48.	0.60	18.18	28.80
43	391.34	145.	0.70	18.88	101.50
44	392.07	28.	0.50	19.38	14.00
45	392.60	16.	0.70	20.08	11.20
46	393.45	21.	0.56	20.64	11.76

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Deep Rock Oil Corporation Lease Main Well No. ML-24

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
370.00 - 380.55	9.03	22.69	204.93
380.55 - 387.10	5.95	62.27	370.50
387.10 - 393.00	5.10	38.63	197.00
381.00 - 390.00	8.85	48.18	426.40

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RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Main Well No. M-24

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	370.60	18.5	21.9	42.2	64.1	314	1.28	1.28	402
2	372.75	19.7	24.0	40.1	64.1	367	1.30	2.58	477
3	373.25	19.8	24.0	47.9	66.9	369	0.95	3.53	350
4	374.53	16.0	31.3	54.8	86.1	388	0.75	4.28	291
F-5	375.52	16.6	25.5	-	-	328	0.32	4.60	105
5	375.82	18.3	28.4	58.0	86.4	403	0.45	5.05	181
6	376.53	20.8	28.5	41.0	69.5	460	0.70	5.75	322
7	376.95	20.2	26.9	41.7	68.6	421	0.65	6.40	274
8	378.06	20.6	30.0	26.0	56.0	479	0.58	6.98	278
9	379.20	20.9	27.2	34.3	61.5	441	1.00	7.98	441
10	379.78	20.6	28.4	33.9	62.3	454	0.60	8.58	272
11	380.40	20.8	31.0	45.2	76.2	500	0.45	9.03	225
F-11	380.89	21.0	40.3	-	-	656	0.60	9.63	394
12	381.61	19.5	39.4	36.7	76.1	595	0.45	10.08	268
13	382.22	19.8	40.4	31.2	71.6	620	0.50	10.58	310
14	382.95	20.0	40.1	49.2	89.3	622	1.15	11.73	715
15	384.28	20.1	43.4	32.9	76.3	676	0.90	12.63	609
16	384.76	20.8	43.3	35.6	77.9	684	0.80	13.43	547
17	385.80	20.9	40.9	40.6	81.5	665	1.90	15.33	1,263

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RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Hein Well No. HL-24

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.	
18	387.20	18.5	32.1	61.7	93.8	461	0.55	15.88	254
19	388.38	17.8	36.7	38.3	75.0	507	0.95	16.83	482
20	388.93	19.9	32.7	50.0	82.7	505	0.45	17.28	228
21	389.20	19.5	33.1	50.8	83.9	501	1.25	18.53	626
22	390.40	20.0	41.1	32.9	74.0	637	0.50	19.03	318
23	391.17	20.1	44.7	36.7	81.4	696	0.75	19.78	523
24	391.88	21.2	41.2	40.6	81.8	677	1.45	21.23	981
							Total - - - - -		11,136

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SUMMARY OF SATURATION TESTS

TABLE IV

Company Deep Rock Oil Corporation Lease Main Well No. ML-24

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
370.00-380.55	9.03	19.48	26.50	41.88	401	3,618
380.55-387.10	6.30	20.44	41.06	39.28	652	4,106
387.10-393.00	5.90	19.73	37.73	43.95	578	3,412
381.00-390.00	8.75	19.89	38.77	42.45	600	5,250

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RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Deep Rock Oil Corporation Lease Mein Well No. ML-24

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	370.10	18.0	23.5	328	0.0	0	23.5	71.7	328	23	0.560	25
2	372.25	19.6	23.0	350	0.0	0	23.0	64.7	350	196	2.70	10
3	372.92	19.3	23.7	348	0.0	0	23.2	74.4	348	36	0.957	25
4	374.35	15.0	32.6	379	0.0	0	32.6	55.8	379	0	Imp.	50+
5	375.53	16.6	25.5	328	0.0	0	25.5	69.8	328	9	0.258	40
6	376.25	20.3	29.2	460	1.3	20	27.9	61.1	440	183	5.93	15
8	377.90	20.8	29.3	473	3.3	53	26.0	67.9	420	99	5.17	15
9	379.38	20.9	27.6	448	1.4	23	26.2	67.0	425	277	13.29	10
10-A	379.60	20.6	27.6	441	4.3	69	23.3	66.7	372	155	5.70	10
11	380.88	21.0	35.3	575	5.6	91	29.7	61.8	484	107	7.06	15
12	381.48	19.1	41.3	613	11.2	166	30.1	62.9	447	123	2.30	15
13	382.08	19.9	39.2	605	8.4	130	30.8	63.0	475	66	3.34	20
14-A	382.50	19.5	41.6	642	10.9	168	30.7	61.7	474	86	2.12	20
15	384.05	20.6	41.5	664	14.0	224	27.5	62.5	440	148	4.88	15
17	385.60	20.8	40.0	645	9.0	145	31.0	59.6	500	115	3.82	15
19-A	388.17	16.8	36.7	479	0.0	0	36.7	41.4	479	0	Imp.	50+
20	388.78	19.6	34.2	520	6.6	100	27.6	61.7	420	81	1.69	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.
"A" samples were taken from the core after it was received in the laboratory.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Deep Rock Oil Corporation Lease Hein Well No. HL-24

Depth Interval, Feet	376.05 - 380.10	380.55 - 389.05	391.00 - 390.00
Feet of Core Analyzed	2.88	5.95	5.50
Average Percent Porosity	20.69	20.27	20.22
Average Percent Original Oil Saturation	28.33	39.68	40.04
Average Percent Oil Recovery	2.36	9.71	10.04
Average Percent Residual Oil Saturation	25.97	29.97	30.00
Average Percent Residual Water Saturation	65.66	61.33	61.31
Average Percent Total Residual Fluid Saturation	91.63	91.30	91.31
Average Original Oil Content, Bbls./A. Ft.	455.	625.	629.
Average Oil Recovery, Bbls./A. Ft.	38.	153.	158.
Average Residual Oil Content, Bbls./A. Ft.	417.	472.	471.
Total Original Oil Content, Bbls./Acre	1,309.	3,720.	3,662.
Total Oil Recovery, Bbls./Acre	109.	911.	870.
Total Residual Oil Content, Bbls./Acre	1,200.	2,809.	2,792.
Average Effective Permeability, Millidarcys	8.30	3.66	3.39
Average Initial Fluid Production Pressure, p.s.i.	12.5	16.5	16.5

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

Oil Field Research Laboratories

RESULTS OF WATER DIFFERENTATION TESTS

TABLE VII

Company Deep Rock Oil Corporation Lease Main Well No. M-24

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1	370.60	8,900			
2	372.75	8,600			
3	373.25	6,400			
4	374.53	11,900			
5	375.82	13,600			
6	376.53	9,700			
7	376.95	11,000			
8	378.06	10,300			
9	379.20	10,100			
10	379.78	10,100			
11	380.40	8,000			
12	381.61	10,600			
13	382.13	11,700			
14	382.95	13,600			
15	384.28	12,200			
16	384.76	11,800			
17	385.80	7,000			
18	387.20	12,700			
19	388.38	16,100			
20	388.93	11,300			
21	389.20	8,600			
22	390.40	10,600			
23	391.17	18,400			
24	391.88	18,900			

Note: ppm - parts per million

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTATION TESTS

TABLE VIII

Company Deep Rock Oil Corporation Lease Hein Well No. HL-24

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
370.00 - 380.55	9,574		
381.40 - 387.10	10,530		
387.10 - 393.00	14,344		
381.00 - 390.00	11,113		

Note: ppm - parts per million.