

HICKORY CREEK OIL COMPANY

CORE ANALYSIS REPORT

WELL NO. HCO-84

W. Berlin 21

OILFIELD RESEARCH LABORATORIES

536 N. HIGHLAND

CHANUTE, KANSAS



OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS 66720 - PHONE (316) 431-2650

January 7, 1980

Hickory Creek Oil Company
1128 Main Street
Parsons, Kansas 67357

Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from Well No. HCO-84, and submitted to our laboratory on December 11, 1979.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman
Benjamin R. Pearman

SAM/tem
4 c to Parsons, Kansas
1 c to Chanute, Kansas



- REGISTERED ENGINEERS -

CORE ANALYSIS - WATER ANALYSIS - REPRESSURING ENGINEERING - SURVEYING & MAPPING - PROPERTY EVALUATION & OPERATION

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Hickory Creek Oil Company Lease - Well No. HCO-84

Location -

Section - Twp - Rge - County - State -

Name of Sand	- - - - -	-
Top of Core	- - - - -	172.0
Bottom of Core	- - - - -	212.0
Top of Sand	- - - - -	172.0
Bottom of Sand	- - - - -	211.6
Total Feet of Permeable Sand	- - - - -	37.9
Total Feet of Floodable Sand	- - - - -	25.8

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 100	14.9	14.9
100 - 200	14.8	29.7
200 - 500	3.0	32.7
500 - 1000	4.2	36.9
1000 - 1500	1.0	37.9

Average Permeability Millidarcys	- - - - -	218.1
Average Percent Porosity	- - - - -	23.1
Average Percent Oil Saturation	- - - - -	48.3
Average Percent Water Saturation	- - - - -	29.3
Average Oil Content, Bbls./A. Ft.	- - - - -	867.
Total Oil Content, Bbls./Acre	- - - - -	33,453.
Average Percent Oil Recovery by Laboratory Flooding Tests	- - - - -	13.1
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	- - - - -	230.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	- - - - -	5944.
Total Calculated Oil Recovery, Bbls./Acre	- - - - -	See "Calculated Recovery" Section.
Packer Setting, Feet	- - - - -	
Viscosity, Centipoises @	- - - - -	
A. P. I. Gravity, degrees @ 60 °F	- - - - -	
Elevation, Feet	- - - - -	

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The core was sampled and the samples sealed in plastic bags by a representative of the client.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
172.0 - 190.4	Brown sandstone.
190.4 - 190.6	Gray sandy shale.
190.6 - 191.2	Brown sandstone.
191.2 - 192.0	Brown slightly shaly sandstone.
192.0 - 192.3	Gray and light brown laminated shale and sandstone.
192.3 - 196.2	Brown sandstone.
196.2 - 196.9	Gray sandy shale.
196.9 - 202.0	Brown sandstone.
202.0 - 206.6	Brown slightly carbonaceous sandstone.
206.6 - 208.0	Light brown slightly shaly sandstone.
208.0 - 208.7	Gray shaly sandstone.
208.7 - 209.7	Light brown sandstone.
209.7 - 210.2	Gray sandy shale.
210.2 - 211.6	Light brown sandstone.
211.6 - 212.0	Gray sandy shale.

LABORATORY FLOODING TESTS

The upper portion of the sand in this core responded well relative to the lower portion of the sand, to laboratory flooding tests, as a total overall recovery of 5,944 barrels of oil per acre was obtained from 25.8 feet of sand. The weighted average percent oil saturation was reduced from 55.4 to 42.3, or

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represents an average recovery of 13.1 percent. The weighted average effective permeability of the samples is 13.14 millidarcys, while the average initial fluid production pressure is 18.1 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 40 samples tested, 26 produced water and oil, and 11 samples produced water only. This indicates that approximately 65 percent of the sand represented by these samples is floodable sand. The tests also show that the sand has an erratic permeability profile.

Please note that the coregraph now presents residual oil saturation instead of recovery, as in the past.

CALCULATED RECOVERY

It would appear from a study of the data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 9,300 barrels of oil per acre. This is an average recovery of 360 barrels per acre foot from 25.8 feet of floodable sand analyzed in this core.

These recovery values were calculated using the following data and assumptions:

Original formation volume factor, estimated	✓ 1.03
Reservoir water saturation, percent, estimated	10.0 / 17.5
Average porosity, percent	22.9 / 23.0
Oil saturation after flooding, percent	42.3 / 42.1
Performance factor, percent, estimated	✓ 45.0
Net floodable sand, feet	25.8 / 21.0

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Hickory Creek Oil Company Lease - DEVLIN #21 Well No. HCO-84

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.		
1 173	172.5	23.1	53	16	69	950	195.	1.0	1.0	950	195.00
2 174	173.5	21.2	57	18	75	938	123.	1.0	2.0	938	123.00
3 175	174.5	26.0	45	13	58	908	122.	1.0	3.0	908	122.00
4 176	175.5	25.6	56	13	69	1112	169.	1.0	4.0	1112	169.00
5 177	176.5	24.9	62	11	73	1198	137.	1.0	5.0	1198	137.00
6 178	177.5	24.2	57	11	68	1070	216.	1.0	6.0	1070	216.00
7 179	178.5	24.3	54	14	68	1018	167.	1.0	7.0	1018	167.00
8 180	179.5	24.3	55	15	70	1037	133.	1.0	8.0	1037	133.00
9 181	180.5	23.2	54	13	67	972	99.	1.0	9.0	972	99.00
10 182	181.5	21.9	59	23	82	1002	77.	1.0	10.0	1002	77.00
11 183	182.5	25.5	60	11	71	1187	188.	1.0	11.0	1187	188.00
12 184	183.5	23.9	57	14	71	1057	79.	1.0	12.0	1057	79.00
13 185	184.5	25.8	60	8	68	1201	256.	1.0	13.0	1201	256.00
14 186	185.5	20.9	55	13	68	892	40.	1.0	14.0	892	40.00
15 187	186.5	22.4	60	13	73	1043	80.	1.0	15.0	1043	80.00
16 188	187.5	21.3	55	16	71	909	68.	1.0	16.0	909	68.00
17 189	188.5	21.1	58	13	71	949	49.	1.0	17.0	949	49.00
18 190	189.5	21.9	55	16	71	935	56.	1.4	18.4	1309	78.40
19 191	190.8	22.5	60	18	78	1047	137.	0.6	19.0	628	82.20
20 192	191.5	20.2	59	26	85	925	25.	0.8	19.8	740	20.00
21 193	192.5	19.3	55	29	84	824	89.	0.7	20.5	577	62.30
22 194	193.5	25.0	51	28	79	989	728.	1.0	21.5	989	728.00
23 195	194.5	19.1	61	26	87	904	208.	1.0	22.5	904	208.00
24 196	195.5	25.6	50	41	91	993	986.	1.2	23.7	1192	1183.20
25 197	196.5	12.2	12	85	97	114	Imp.	0.7	24.4	80	0.00
26 198	197.5	19.4	50	27	77	753	71.	1.1	25.5	828	78.10
27 199	198.5	27.3	42	33	75	890	145.	1.0	26.5	890	145.00
28 200	199.5	28.4	37	59	96	815	804.	1.0	27.5	815	804.00
29 201	200.5	28.8	32	62	94	715	1132.	1.0	28.5	715	1132.00
30 202	201.5	24.4	34	50	84	644	728.	1.0	29.5	644	728.00

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Hickory Creek Oil Company Lease D - 21 Well No. HCO-84

7680.3

917.2

1199

8230

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.		
31 207	202.5	22.3	47	35	82	813	13.	1.0	30.5	813	13.00
32 209	203.5	23.9	35	45	80	649	130.	1.0	31.5	649	130.00
33 205	204.5	24.8	37	51	88	712	188.	1.0	32.5	712	188.00
34 206	205.5	22.6	42	45	87	736	113.	1.0	33.5	736	113.00
35 207	206.5	21.9	29	60	89	493	121.	0.6	34.1	296	72.60
36 208	207.5	20.5	33	48	81	525	28.	1.4	35.5	735	39.20
37 209	208.5	22.0	30	42	72	512	38.	0.7	36.2	410	30.40
38 210	209.5	24.8	29	55	84	558	130.	1.0	37.2	558	130.00
39 211	210.5	20.1	38	35	73	593	35.	0.8	38.0	474	28.00
40 212	211.5	20.6	33	48	81	527	127.	0.6	38.6	316	76.20

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Hickory Creek Oil Company Lease — Well No. HCO-84

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
172.0 - 182.0	10.0	143.8	1438.00
182.0 - 191.2	9.0	102.3	920.60
191.2 - 211.6	18.9	312.6	5908.90
172.0 - 211.6	37.9	218.1	8267.50

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
172.0 - 182.0	10.0	23.9	55.2	14.7	1021	10,205
182.0 - 191.2	9.0	22.8	57.6	13.5	1019	9,175
191.2 - 211.6	19.6	22.9	40.5	44.0	718	14,073
172.0 - 211.6	38.6	23.1	48.3	29.3	867	33,453

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Hickory Creek Oil Company Lease - DEVLIN #21 Well No. HCO-84

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	172.5	22.8	53	937	20	354	33	57	583	380	27.00	20
2	173.5	21.4	57	946	13	216	44	44	730	325	11.66	15
3	174.5	25.5	45	890	9	178	36	53	712	201	8.66	20
4	175.4	25.4	56	1103	22	434	34	54	669	371	13.66	10
5	176.5	24.7	62	1188	10	192	52	43	996	244	18.49	10
6	177.5	24.2	57	1070	23	432	34	55	638	390	16.86	15
7	178.5	24.3	54	1018	11	207	43	42	811	281	11.57	10
8	179.5	24.1	55	1028	15	280	39	53	748	276	19.66	30
9	180.5	23.1	54	968	18	323	36	50	645	249	10.31	15
10	181.5	22.3	59	1021	24	415	35	53	606	298	18.66	15
11	182.5	25.5	60	1187	14	277	46	42	910	192	11.57	15
12	183.5	24.1	57	1066	16	299	41	47	767	211	17.49	15
13	184.5	25.6	60	1192	16	318	44	47	874	252	15.42	15
14	185.5	21.3	55	909	17	281	38	58	628	323	10.50	15
15	186.5	22.1	60	1029	17	291	43	48	738	209	5.24	25
16	187.5	21.1	55	900	12	196	43	52	704	151	3.90	25
17	188.5	20.9	58	940	16	259	42	52	681	138	3.15	25
18	189.5	21.8	55	930	10	169	45	48	761	116	2.70	25
19	190.8	22.3	60	1038	14	242	46	50	769	245	5.40	25
20	191.5	20.4	59	934	11	174	48	43	760	306	11.99	20
21	192.5	19.3	55	824	8	120	47	50	704	159	12.99	15
22	193.5	25.1	51	993	4	78	47	49	915	209	28.49	10
23	194.5	19.1	61	904	9	133	52	47	771	204	17.69	10
24	195.5	25.8	50	1001	8	160	42	56	841	359	33.00	10
25	196.5	12.3	13	124	0	0	13	83	124	0	Imp.	-
26	197.5	19.2	50	745	3	45	47	48	700	86	1.95	30
27	198.5	27.0	42	880	0	0	42	47	880	233	9.00	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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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Hickory Creek Oil Company

Lease D-21

Well No. HCO-84

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.			
							1567				512.256	
28	199.5	28.8	37	827	0	0	37	53	827	257	48.98	10
29	200.5	28.6	32	710	0	0	32	65	710	320	35.99	10
30	201.5	24.7	34	652	0	0	34	64	652	241	24.37	10
31	202.5	22.0	47	802	2	34	45	46	768	66	1.50	30
32	203.5	23.6	35	641	0	0	35	59	641	350	10.49	10
33	204.5	24.4	37	701	0	0	37	59	701	295	10.31	10
34	205.5	22.4	42	730	0	0	42	57	730	367	10.87	10
35	206.5	22.0	29	495	0	0	29	66	495	240	11.14	10
36	207.5	20.1	33	514	0	0	33	64	514	87	1.95	25
37	208.5	21.7	30	505	0	0	30	61	505	8	0.15	40
38	209.5	24.4	29	549	0	0	29	64	549	366	9.50	10
39	210.5	20.1	38	593	0	0	38	58	593	0	Imp.	-
40	211.5	20.3	34	535	0	0	34	60	535	0	Imp.	-

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	Hickory Creek Oil Company			Lease	-	Well No.	HCO-84
Depth Interval, Feet	172.0 - 182.0	182.0 - 191.2	191.2 - 211.6	172.0 - 211.6			
Feet of Core Analyzed	10.0	9.0	6.8	25.8			
Average Percent Porosity	23.8	22.7	21.8	22.9			
Average Percent Original Oil Saturation	55.1	57.6	52.9	55.4			
Average Percent Oil Recovery	16.5	14.5	6.2	13.1			
Average Percent Residual Oil Saturation	38.6	43.1	46.7	42.3			
Average Percent Residual Water Saturation	50.4	49.2	48.7	49.6			
Average Percent Total Residual Fluid Saturation	89.0	92.3	95.4	91.9			
Average Original Oil Content, Bbls./A. Ft.	1017.	1015.	888.	978.			
Average Oil Recovery, Bbls./A. Ft.	303.	256.	104.	230.			
Average Residual Oil Content, Bbls./A. Ft.	714.	759.	784.	748.			
Total Original Oil Content, Bbls./Acre	10,169.	9,032.	6,044.	25,245.			
Total Oil Recovery, Bbls./Acre	3,031.	2,203.	710.	5,944.			
Total Residual Oil Content, Bbls./Acre	7,138.	6,829.	5,334.	19,301.			
Average Effective Permeability, Millidarcys	15.65	8.25	15.90	13.14			
Average Initial Fluid Production Pressure, p.s.i.	16.0	20.6	17.9	18.1			

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