

HICKORY CREEK OIL COMPANY

CORE ANALYSIS REPORT

WELL NO. HCO-70

W. Berlin 18

OILFIELD RESEARCH LABORATORIES

536 N. HIGHLAND

CHANUTE, KANSAS



OILFIELD RESEARCH LABORATORIES

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

December 28, 1979

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-70, and submitted to our laboratory on December 3, 1979.

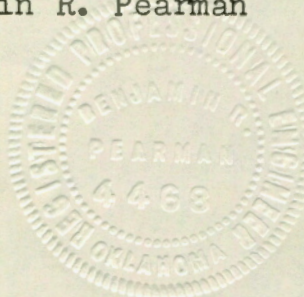
Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman
Benjamin R. Pearman

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



Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Hickory Creek Oil Company Lease - Well No. HCO-70

Location -

Section - Twp. - Rge. - County - State -

Name of Sand	- - - - -	-
Top of Core	- - - - -	171.0
Bottom of Core	- - - - -	211.0
Top of Sand	- - - - -	171.0
Bottom of Sand	- - - - -	211.0
Total Feet of Permeable Sand	- - - - -	38.3
Total Feet of Floodable Sand	- - - - -	28.5

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 50	16.7	16.7
50 - 100	12.8	29.5
100 - 200	2.0	31.5
200 - 400	6.8	38.3

Average Permeability Millidarcys	- - - - -	86.3
Average Percent Porosity	- - - - -	20.2
Average Percent Oil Saturation	- - - - -	47.7
Average Percent Water Saturation	- - - - -	30.0
Average Oil Content, Bbls./A. Ft.	- - - - -	752.
Total Oil Content, Bbls./Acre	- - - - -	28,799.
Average Percent Oil Recovery by Laboratory Flooding Tests	- - - - -	10.9
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	- - - - -	187.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	- - - - -	5,329.
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>
171.0 - 171.5	Brown slightly shaly sandstone.
171.5 - 172.5	Gray shale.
172.5 - 180.3	Brown sandstone containing thin widely scattered carbon partings.
180.3 - 181.1	Brown sandstone laminated with thin carbon partings.
181.1 - 182.3	Brown sandstone.
182.3 - 182.7	Brown and gray laminated sandstone and shale.
182.7 - 186.0	Brown sandstone.
186.0 - 191.0	Light brown shaly sandstone.
191.0 - 193.6	Brown slightly shaly sandstone.
193.6 - 194.3	Gray sandy shale.
194.3 - 199.1	Brown slightly shaly sandstone.
199.1 - 202.8	Light brown shaly sandstone.
202.8 - 211.0	Brown slightly shaly sandstone.

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 5,329 barrels of oil per acre was obtained from 28.5 feet of sand. The weighted average percent oil saturation was reduced from 50.6 to 39.7, or represents an average recovery of 10.9 percent. The weighted

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average effective permeability of the samples is 8.83 millidarcys, while the average initial fluid production pressure is 24.3 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 40 samples tested, 30 produced water and oil, and 6 samples produced water only. This indicates that approximately 75 percent of the sand represented by these samples is floodable sand. The tests also show that the sand has an erratic permeability profile.

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 9,970 barrels of oil per acre. This is an average recovery of 350 barrels per acre foot from 28.5 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 / 14.7 ✓
Average porosity, percent	21.0 / 22.2 ✓
Oil saturation after flooding, percent	39.7 / 36.0 ✓
Performance factor, percent, estimated	✓ 45.0 ✓
Net floodable sand, feet	28.5 / 15.0 ✓

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

DEVLIN #18

Company Hickory Creek Oil Company

Lease -

Well No. HCO-70

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	171.4	16.5	54	17	71	691	99.	0.5	0.5	346	49.50
2	172.6	20.3	59	20	79	929	329.	0.5	1.0	465	164.50
3	173.4	22.4	54	14	68	938	292.	1.0	2.0	938	292.00
4	174.5	22.5	58	16	74	1012	10.	1.0	3.0	1012	10.00
5	175.5	23.9	55	19	74	1020	253.	1.0	4.0	1020	253.00
6	176.5	24.4	60	12	72	1136	244.	1.0	5.0	1136	244.00
7	177.5	23.6	50	18	68	915	210.	1.0	6.0	915	210.00
8	178.5	24.3	52	17	69	980	250.	1.0	7.0	980	250.00
9	179.5	25.2	51	15	66	997	314.	1.3	8.3	1296	408.20
10	180.5	22.3	50	24	74	865	118.	0.8	9.1	692	94.80
11	181.5	22.3	59	18	77	1021	110.	1.2	10.3	1225	132.00
12	182.4	20.6	34	25	59	543	1.8	0.4	10.7	217	0.72
13	183.5	23.8	59	8	67	1089	84.	1.3	12.0	1416	109.20
14	184.5	23.2	59	11	70	1062	86.	1.0	13.0	1062	86.00
15	185.3	18.8	64	16	80	933	83.	1.0	14.0	933	83.00
16	186.5	14.8	38	53	91	436	2.1	1.0	15.0	436	2.10
17	187.3	14.9	41	46	87	474	6.0	1.0	16.0	474	6.00
18	188.5	13.6	46	52	98	485	6.9	1.0	17.0	485	6.90
19	189.6	16.8	48	41	89	626	8.2	1.0	18.0	626	8.20
20	190.6	16.6	51	39	90	657	31.	1.0	19.0	657	31.00
21	191.3	19.6	51	29	80	776	11.	1.0	20.0	776	11.00
22	192.4	20.7	45	29	74	723	28.	1.0	21.0	723	28.00
23	193.4	21.2	46	29	75	757	20.	0.6	21.7	454	12.00
24	194.4	20.8	49	30	79	791	52.	0.7	22.3	554	36.40

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

DEVLIN #18

Company Hickory Creek Oil Company

Lease -

Well No. HCO-70

7639.1

802.9

1200

3406.6

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.		
25	195.5	21.4	44	27	71	731	32.	1.0	23.3	731	32.00
26	196.5	22.1	44	30	74	754	90.	1.0	24.3	754	90.00
27	197.5	20.0	43	36	79	667	96.	1.0	25.3	667	96.00
28	198.5	22.0	48	32	80	819	82.	1.1	26.4	901	90.20
29	199.5	18.3	42	39	81	596	7.5	0.9	27.3	536	6.75
30	200.5	19.5	40	39	79	605	13.	1.0	28.3	605	13.00
31	201.5	15.9	52	37	89	641	4.7	1.0	29.3	641	4.70
32	202.5	15.3	57	39	96	677	4.4	0.8	30.0	542	3.52
33	203.5	17.4	50	38	88	675	59.	1.2	31.3	810	70.80
34	204.5	20.6	41	36	77	655	56.	1.0	32.3	655	56.00
35	205.5	16.1	46	44	90	575	69.	1.0	33.3	575	69.00
36	206.5	22.5	26	27	53	454	34.	1.0	34.3	454	34.00
37	207.5	19.8	32	46	78	492	22.	1.0	35.3	492	22.00
38	208.5	19.8	34	52	86	522	99.	1.0	36.3	522	99.00
39	209.5	19.4	40	47	87	602	69.	1.0	37.3	602	69.00
40	210.5	19.7	31	33	64	474	20.	1.0	38.3	474	20.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Hickory Creek Oil Company Lease — Well No. HCO-70

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
171.0 - 182.7	10.7	197.1	2108.72
182.7 - 211.0	27.6	43.3	1195.77
171.0 - 211.0	38.3	86.3	3304.49

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
171.0 - 182.7	10.7	22.9	53.9	17.3	957	10,242
182.7 - 211.0	27.6	19.1	45.3	35.0	672	18,557
171.0 - 211.0	38.3	20.2	47.7	30.0	752	28,799

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

DEVLIN #18

Company Hickory Creek Oil Company Lease - Well No. HCO-70

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.
			%	Bbbs./A. Ft.	%	Bbbs./A. Ft.	% Oil	% Water	Bbbs./A. Ft.			
1	171.4	16.8	54	704	20	261	34	55	443	288	11.50	20
2	172.6	20.0	59	915	21	326	38	55	589	60	2.70	20
3	173.4	22.3	54	934	21	363	33	55	571	257	22.85	15
4	174.5	22.5	58	1012	21	367	37	51	645	212	15.37	15
5	175.5	23.8	55	1016	16	295	39	54	721	323	33.23	10
6	176.5	24.5	60	1140	25	475	35	56	665	230	31.15	15
7	177.5	23.6	50	915	18	330	32	56	585	290	28.13	15
8	178.5	24.0	52	968	19	354	33	59	614	255	42.47	10
9	179.5	24.8	51	981	16	308	35	51	673	115	19.15	10
10	180.5	22.0	50	853	18	307	32	50	546	8	0.15	35
11	181.5	21.9	59	1002	21	357	38	53	645	77	2.80	25
12	182.4	20.6	34	543	3	48	31	58	495	50	1.80	25
13	183.5	24.1	59	1103	16	299	43	49	804	71	2.30	25
14	184.5	23.1	59	1057	16	287	43	49	770	138	4.30	25
15	185.3	19.1	64	948	17	252	37	36	696	16	0.40	35
16	186.5	15.0	38	442	0	0	38	53	442	0	Imp.	-
17	187.3	14.9	40	462	0	0	40	50	462	0	Imp.	-
18	188.5	13.8	45	482	0	0	45	50	482	0	Imp.	-
19	189.6	17.0	48	633	0	0	48	53	633	4	0.20	50
20	190.6	16.9	51	669	4	52	47	43	617	8	0.20	40
21	191.3	19.0	51	752	5	74	46	48	678	236	5.30	20
22	192.4	20.7	45	723	5	80	40	54	643	101	3.20	25
23	193.4	21.4	46	764	5	83	41	53	681	371	7.20	20
24	194.4	21.0	49	799	7	114	42	52	684	154	3.90	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.

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

DEVLIN #18

Company Hickory Creek Oil Company Lease - Well No. HCO-70

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.			
							1565				273.84	
25	195.5	21.4	44	730	2	33	42	51	697	72	2.30	30
26	196.5	22.5	44	768	0	0	44	53	768	391	10.30	20
27	197.5	20.4	43	681	3	47	40	52	634	192	5.00	20
28	198.5	21.8	48	812	6	101	42	50	711	137	3.60	25
29	199.5	18.5	42	603	2	29	40	53	574	11	0.30	40
30	200.5	19.3	40	598	2	30	38	53	568	16	0.30	35
31	201.5	16.4	52	662	4	51	48	42	611	2	0.20	50
32	202.5	15.5	57	685	0	0	57	33	685	0	Imp.	-
33	203.5	17.0	50	659	6	79	44	53	502	27	0.50	25
34	204.5	20.5	41	652	2	32	39	56	620	63	1.60	35
35	205.5	16.6	46	592	3	39	43	50	553	47	1.20	20
36	206.5	22.3	26	450	0	0	26	62	450	20	0.40	35
37	207.5	20.1	32	499	0	0	32	62	499	150	3.60	15
38	208.5	20.0	33	512	0	0	33	64	512	317	2.74	10
39	209.5	19.8	40	614	2	31	38	57	583	132	3.30	15
40	210.5	19.6	32	487	0	0	32	57	487	13	0.20	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.

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Hickory Creek Oil Company		Lease	-	Well No.	HCO-70
Depth Interval, Feet	171.0 - 182.7	182.7 - 211.0	171.0 - 211.0			
Feet of Core Analyzed	10.7	17.8	28.5			
Average Percent Porosity	22.8	19.9	21.0			
Average Percent Original Oil Saturation	53.9	48.6	50.6			
Average Percent Oil Recovery	18.9	6.1	10.9			
Average Percent Residual Oil Saturation	35.0	42.5	39.7			
Average Percent Residual Water Saturation	54.1	50.0	51.5			
Average Percent Total Residual Fluid Saturation	89.1	92.5	91.2			
Average Original Oil Content, Bbls./A. Ft.	941.	745.	822.			
Average Oil Recovery, Bbls./A. Ft.	334.	99.	187.			
Average Residual Oil Content, Bbls./A. Ft.	617.	646.	635.			
Total Original Oil Content, Bbls./Acre	10,172.	13,261.	23,433.			
Total Oil Recovery, Bbls./Acre	3,571.	1,758.	5,329.			
Total Residual Oil Content, Bbls./Acre	6,601.	11,503.	18,104.			
Average Effective Permeability, Millidarcys	19.57	2.37	8.83			
Average Initial Fluid Production Pressure, p.s.i.	17.9	28.6	24.3			

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

Nov, 30, 1979 clear + cold

Devlin #13 HCO# 70

Core #2 191.1-210.97

191.1-195.2

Sandstone, fine grained, brown
many shale pebbles $> \frac{1}{4}$ " in thickness
plant fragments on broken surface
at 191.4. Sand shale
interfused at 193.5 $\approx 70^\circ$
from axis of core. Interval
finely laminated with carbonaceous
material

195.2-

Sandstone fine grained, brown
micaceous

Shale pebbles at (197.3-197.5),
199.8

At 200.9 numerous carbonaceous
laminations grading into shaley sand
interval at 201.1-201.4. Carbonaceous
breaks with plant fragments at
202, 203.5 + 206.4. Shale
segment from 206.4-206.5
Shale is gray + silty.
Free oil seeps through interval
H₂O bleeding at 208 noticed.

~~End Core 2nd~~
~~Devlin 13~~