

HICKORY CREEK OIL COMPANY

CORE ANALYSIS REPORT

WELL NO. HCO-91

W. Berlin 27

OILFIELD RESEARCH LABORATORIES

536 N. HIGHLAND

CHANUTE, KANSAS



OILFIELD RESEARCH LABORATORIES

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

January 19, 1980

Hickory Creek Oil Company
1128 Main Street
Parsons, Kansas 67357

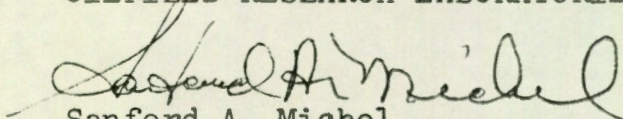
Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from Well No. HCO-91, and submitted to our laboratory on December 19, 1979.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES


Sanford A. Michel

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-91

Location -

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

Elevation, Feet - - - - -

Name of Sand - - - - -

Top of Core - - - - - 163.0

Bottom of Core - - - - - 203.6

Top of Sand - - - - - 164.0

Bottom of Sand - - - - - 203.6

Total Feet of Permeable Sand - - - - - 36.5

Total Feet of Floodable Sand - - - - - 22.9

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

0 - 20	14.2	14.2
20 - 50	12.2	26.4
50 - 100	4.5	30.9
100 - 200	3.6	34.5
200 - 400	2.0	36.5

Average Permeability Millidarcys - - - - - 51.3

Average Percent Porosity - - - - - 19.7

Average Percent Oil Saturation - - - - - 49.1

Average Percent Water Saturation - - - - - 31.7

Average Oil Content, Bbls./A. Ft. - - - - - 746.

Total Oil Content, Bbls./Acre - - - - - 27,245.

Average Percent Oil Recovery by Laboratory Flooding Tests - - - - - 12.6

Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. - - - - - 196.

Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre - - - - - 4,479.

Total Calculated Oil Recovery, Bbls./Acre - - - - - See "Calculated Recovery" Section.

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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>
163.0 - 164.0	Gray sandy shale.
164.0 - 165.1	Brown slightly shaly sandstone.
165.1 - 166.1	Gray very shaly sandstone.
166.1 - 168.0	Brown and gray laminated sandstone and shale.
168.0 - 170.6	Dark brown sandstone.
170.6 - 171.4	Light brown shaly sandstone.
171.4 - 173.8	Dark brown sandstone.
173.8 - 177.7	Grayish brown shaly sandstone.
177.7 - 185.8	Brown sandstone.
185.8 - 186.8	Grayish brown slightly shaly sandstone.
186.8 - 187.9	Gray sandy shale.
187.9 - 188.8	Brown sandstone.
188.8 - 190.0	Gray sandy shale.
190.0 - 203.6	Dark brown 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 4,479 barrels of oil per acre was obtained from 22.9 feet of sand. The weighted average percent oil saturation was reduced from 50.2 to 37.6, or represents an average recovery of 12.6 percent. The weighted

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average effective permeability of the samples is 0.84 millidarcys, while the average initial fluid production pressure is 30.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 38 samples tested, 24 produced water and oil, and 5 samples produced water only. This indicates that approximately 63 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a relatively low permeability profile.

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

CALCULATED RECOVERY

It would appear from a study of the core data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 7,780 barrels of oil per acre. This is an average recovery of 318 barrels per acre foot from 22.9 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	15.0 / 22.9 ✓
Average porosity, percent	20.3 / 21.0 ✓
Oil saturation after flooding, percent	37.6 / 36.4 ✓
Performance factor, percent, estimated	✓ 45.0
Net floodable sand, feet	22.9 / 18.0 ✓

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Hickory Creek Oil Company Lease - D27 Well No. HCO-91

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	164.5	17.4	54	36	90	729	10.	1.1	1.1	802	11.00
2	165.5	13.0	44	44	88	444	0.40	1.0	2.1	444	0.40
3	166.5	17.5	45	40	85	611	12.	0.9	3.0	550	10.80
4	167.5	18.8	53	31	84	773	8.5	1.0	4.0	773	8.50
5	168.5	20.8	47	22	69	758	19.	1.0	5.0	758	19.00
6	169.2	22.0	46	25	71	785	43.	1.0	6.0	785	43.00
7	170.5	18.4	54	33	87	771	68.	0.6	6.6	463	40.80
8	171.6	19.8	46	32	78	707	38.	0.6	7.2	424	22.80
9	172.5	19.2	51	27	78	760	13.	1.0	8.2	760	13.00
10	173.5	21.3	53	22	75	876	49.	0.8	9.0	701	39.20
11	174.5	16.9	37	49	86	485	9.2	1.0	10.0	485	9.20
12	175.5	17.7	53	42	95	728	9.5	1.0	11.0	728	9.50
13	176.8	16.4	41	46	87	522	0.50	1.1	12.1	574	0.55
14	177.5	18.1	52	40	92	730	7.8	0.8	12.9	584	6.24
15	178.5	19.8	55	32	87	845	17.	1.3	14.2	1099	22.10
16	179.5	19.8	57	30	87	876	14.	1.0	15.2	876	14.00
17	180.5	22.1	50	21	71	857	46.	1.0	16.2	857	46.00
18	181.5	21.1	51	26	77	835	24.	1.0	17.2	835	24.00
19	182.5	18.4	42	47	89	600	12.	1.0	18.2	600	12.00
20	183.5	20.2	50	32	82	784	24.	1.0	19.2	784	24.00
21	184.5	17.9	50	41	91	694	45.	1.0	20.2	694	45.00
22	185.5	21.2	57	24	81	938	41.	0.8	21.0	750	32.80
23	186.5	22.4	54	29	83	938	15.	1.0	22.0	938	15.00
24	188.5	20.1	49	24	73	764	65.	0.9	22.9	688	58.50
25	190.5	20.0	56	19	75	869	54.	1.0	23.9	869	54.00
26	191.5	20.9	61	17	78	989	47.	1.0	24.9	989	47.00
27	192.5	20.1	60	15	75	936	31.	1.0	25.9	936	31.00
28	193.5	18.3	56	28	84	795	25.	1.0	26.9	795	25.00

h=17.9

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Hickory Creek Oil Company Lease - D 27 Well No. HCO-91

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.		
	6983.1	744.3		1204			1979.90				
29	194.5	23.2	45	25	70	810	41.	1.0	27.9	810	41.00
30	195.5	21.9	37	30	67	629	52.	1.0	28.9	629	52.00
31	196.5	22.7	44	27	71	775	113.	1.0	29.9	775	113.00
32	197.5	22.2	45	25	70	775	57.	1.0	30.9	775	57.00
33	198.5	20.2	46	31	77	721	25.	1.0	31.9	721	25.00
34	199.5	24.6	39	30	69	744	336.	1.0	32.9	744	336.00
35	200.5	24.5	35	47	82	665	218.	1.0	33.9	665	218.00
36	201.5	16.7	53	37	90	687	170.	1.0	34.9	687	170.00
37	202.5	15.6	50	38	88	605	111.	1.0	35.9	605	111.00
38	203.5	13.1	48	40	88	488	109.	0.6	36.5	293	65.40

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Hickory Creek Oil Company Lease — Well No. HCO-91

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
164.0 - 193.0	25.9	25.5	659.39
193.0 - 203.6	10.6	114.5	1,213.40
164.0 - 203.6	36.5	51.3	1,872.79

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
164.0 - 193.0	25.9	19.3	50.7	31.4	762	19,746
193.0 - 203.6	10.6	20.6	45.2	32.3	707	7,499
164.0 - 203.6	36.5	19.7	49.1	31.7	746	27,245

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Hickory Creek Oil Company Lease - D27 Well No. HCO-91

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	164.5	17.2	54	721	0	0	54	40	721	0	Imp.	-
2	165.5	13.1	44	447	0	0	44	46	447	0	Imp.	-
3	166.5	17.8	45	621	12	166	33	63	455	30	0.45	20
4	167.5	18.4	53	757	0	0	53	35	757	18	0.30	40
5	168.5	20.6	47	751	15	240	32	66	511	12	0.15	20
6	169.2	22.0	46	785	15	256	31	65	529	106	2.70	20
7	170.5	18.6	54	779	21	303	33	62	476	20	0.30	30
8	171.6	20.0	46	714	16	248	30	50	466	20	0.45	25
9	172.5	18.9	51	748	20	293	31	63	455	12	0.15	30
10	173.5	21.1	53	868	22	360	31	67	508	62	1.05	15
11	174.5	17.0	37	488	0	0	37	58	488	0	Imp.	-
12	175.5	17.7	53	728	0	0	53	40	728	0	Imp.	-
13	176.8	16.6	41	528	0	0	41	46	528	0	Imp.	-
14	177.5	17.8	53	732	0	0	53	41	732	0	Imp.	-
15	178.5	19.6	55	836	13	198	42	52	638	4	0.15	30
16	179.5	19.7	57	871	17	260	40	58	611	4	0.15	45
17	180.5	22.1	50	857	20	343	30	64	514	26	0.45	25
18	181.5	20.9	51	827	15	243	36	50	584	6	0.15	40
19	182.5	18.3	42	596	11	156	31	52	440	6	0.15	25
20	183.5	20.2	50	784	10	157	40	32	627	8	0.15	30
21	184.5	18.1	50	702	16	225	34	48	477	12	0.22	25
22	185.5	21.0	57	929	14	228	43	37	701	20	0.30	25
23	186.5	22.2	54	930	0	0	54	32	930	0	Imp.	-
24	188.5	20.2	49	768	11	172	38	57	596	72	1.50	30
25	190.5	20.3	56	882	14	220	42	53	662	48	0.90	30
26	191.5	21.0	61	994	11	179	50	45	815	114	2.25	25
27	192.5	20.3	60	945	15	236	45	43	709	4	0.15	50
28	193.5	18.3	56	795	0	0	56	33	795	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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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Hickory Creek Oil Company Lease - D27 Well No. HCO-91

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.			
							1559				56.20	
29	194.5	23.2	45	810	3	54	42	46	756	50	1.12	45
30	195.5	21.8	37	626	2	34	35	58	592	20	0.52	45
31	196.5	23.0	44	785	2	36	42	47	749	70	1.42	35
32	197.5	22.2	45	775	3	52	42	53	723	190	3.90	25
33	198.5	20.0	46	714	0	0	46	50	714	88	1.57	25
34	199.5	24.4	39	738	0	0	39	58	738	266	12.21	20
35	200.5	24.7	35	671	0	0	35	61	671	272	20.99	20
36	201.5	17.0	53	699	10	132	43	46	567	56	0.90	35
37	202.5	15.9	50	617	0	0	50	47	617	46	1.50	30
38	203.5	13.1	48	488	0	0	48	44	488	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-91
Depth Interval, Feet	164.0 - 193.0	193.0 - 203.6	164.0 - 203.6			
Feet of Core Analyzed	17.9	5.0	22.9			
Average Percent Porosity	20.1	21.2	20.3			
Average Percent Original Oil Saturation	51.7	44.8	50.2			
Average Percent Oil Recovery	15.0	4.0	12.6			
Average Percent Residual Oil Saturation	36.7	40.8	37.6			
Average Percent Residual Water Saturation	53.9	50.0	53.1			
Average Percent Total Residual Fluid Saturation	90.6	90.8	90.7			
Average Original Oil Content, Bbls./A. Ft.	805.	739.	791.			
Average Oil Recovery, Bbls./A. Ft.	233.	62.	196.			
Average Residual Oil Content, Bbls./A. Ft.	572.	677.	595.			
Total Original Oil Content, Bbls./Acre	14,413.	3,695.	18,108.			
Total Oil Recovery, Bbls./Acre	4,171.	308.	4,479.			
Total Residual Oil Content, Bbls./Acre	10,242.	3,387.	13,629.			
Average Effective Permeability, Millidarcys	0.63	1.57	0.84			
Average Initial Fluid Production Pressure, p.s.i.	28.4	37.0	30.2			

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

Dec 18 clear + cool J.5

Devlin 27 HCO* 91

Core # 1 (163-182.7) cased 20'

(163-164)

Shale gray a few sandy streaks through

(164-176)

Sandstone fng, brown sugar

Sandy Shale breaks (165.2-165.5)

(166-166.1), (166.2-167.5) $\frac{1}{2}$ " at

167.9, (170.6-170.7), (171.1-171.3),

(173.8-174.1)

Shale pebble 169.5 2" by $\frac{3}{4}$ "

(176-177.4)

Shale gray

Sandy streaks oozing

oil 176.1, (176.5-176.9),

(177-177.4).

(177.4-182.7)

Sandstone fng, brown sugar

Shale pebble 182.6 $\frac{1}{2}$ " by $\frac{3}{4}$ "

Sand is very clean

All sand + sandy zones

ooze oil freely + in large

Am'ts No presence of water

Pit very heavy with oil!

End Core # 1

HCO* 91

Dec 18 Night J.J.

Devlin 27 HCO #91

Core #2 (1827-203.6)

1827-186.8

Sandstone fng, brown

Shale 48" thick 185.9, + 1/2" thick

186.2

186.8-1829

Shale, gray, silty

1829-188.5

Sandstone fng, brown, Shale

rip clsts 188 1" by 3/8" + 188.4

1" by 1/2"

188.95-190-

Shale, gray

190-203.7

Sandstone fng brown. Shale

pebble 191. 1" by 1/4". Shale +

carbonaceous laminations (192.8-192.9),

(194.2-194.5), (195.6-195.9)

large shale rip clst 202 2" by 3/4".

Entire sand oozes free oil to

196.2 Sand becomes waxy

beyond here but still oozes

some oil.

End Core #2

HCO #91