HICKORY CREEK OIL COMPANY

CORE ANALYSIS REPORT

WELL NO. HCO-52

R. Vilmer 3

OILFIELD RESEARCH LABORATORIES

536 N. HIGHLAND CHANUTE, KANSAS

# OILFIELD RESEARCH LABORATORIES

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


November 2, 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-52, and submitted to our laboratory on October 18, 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-52

Location -

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

| | |
|---|---|
| Name of Sand | - |
| Top of Core | 170.4 |
| Bottom of Core | 211.0 |
| Top of Sand | 170.4 |
| Bottom of Sand | 210.7 |
| Total Feet of Permeable Sand | 40.3 |
| Total Feet of Floodable Sand | 25.0 |

Distribution of Permeable Sand:

| Permeability Range Millidarcys | Feet | Cum. Ft. |
|---|---|---|
| 0 - 50 | 13.8 | 13.8 |
| 50 - 100 | 11.5 | 25.3 |
| 100 - 200 | 12.0 | 37.3 |
| 200 - 300 | 1.0 | 38.3 |
| 300 - 400 | 2.0 | 40.3 |

| | |
|---|---|
| Average Permeability Millidarcys | 91.5 |
| Average Percent Porosity | 22.4 |
| Average Percent Oil Saturation | 46.8 |
| Average Percent Water Saturation | 30.3 |
| Average Oil Content, Bbls./A. Ft. | 813. |
| Total Oil Content, Bbls./Acre | 32,774. |
| Average Percent Oil Recovery by Laboratory Flooding Tests | 12.9 |
| Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. | 231. |
| Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre | 5,785. |
| Total Calculated Oil Recovery, Bbls./Acre | See "Calculated Recovery" Section. |
| Packer Setting, Feet | |
| Viscosity, Centipoises @ | |
| A. P. I. Gravity, degrees @ 60 °F | |
| Elevation, Feet | |

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:

| Depth Interval, Feet | Description |
|---|---|
| 170.4 - 174.0 | Brown sandstone. |
| 174.0 - 175.0 | Brown sandstone with fine carbonaceous laminations. |
| 175.0 - 177.0 | Brown sandstone. |
| 177.0 - 178.0 | Brown sandstone with fine carbonaceous laminations. |
| 178.0 - 180.3 | Brown sandstone. |
| 180.3 - 180.9 | Brown slightly shaly, slightly carbonaceous sandstone. |
| 180.9 - 181.9 | Brown shaly sandstone. |
| 181.9 - 183.1 | Brown sandstone. |
| 183.1 - 184.0 | Brown slightly carbonaceous sandstone. |
| 184.0 - 192.0 | Brown sandstone. |
| 192.0 - 193.3 | Brown slightly shaly, slightly carbonaceous sandstone. |
| 193.3 - 194.0 | Brown sandstone. |
| 194.0 - 196.0 | Brown slightly shaly sandstone. |
| 196.0 - 203.3 | Brown sandstone. |
| 203.3 - 204.0 | Brown sandstone with fine carbonaceous laminations. |
| 204.0 - 210.7 | Brown sandstone. |
| 210.7 - 211.0 | Gray sandy shale with fine carbonaceous laminations. |

VILMER 3



## LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 5,785 barrels of oil per acre was obtained from 25.0 feet of sand. The weighted average percent oil saturation was reduced from 50.7 to 37.8, or represents an average recovery of 12.9 percent. The weighted average effective permeability of the samples is 12.99 millidarcys, while the average initial fluid production pressure is 18.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 41 samples tested, 25 produced water and oil, and 11 samples produced water only. This indicates that approximately 61 percent of the sand represented by these samples is floodable pay sand.

## 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 9,700 barrels of oil per acre. This is an average recovery of 388 barrels per acre foot from 25.0 feet of floodable sand analyzed in this core.

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

| | |
|---|---|
| Original formation volume factor | 1.03 |
| Reservoir water saturation, percent | 10.0 / 17.6 |
| Average porosity, percent | 22.4 / 23.3 |
| Oil saturation after flooding, percent | 37.8 / 35.5 |
| Performance factor, percent | 45.0 |
| Net floodable pay sand, feet | 25.0 / 14.0 |

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**RESULTS OF SATURATION & PERMEABILITY TESTS**

**TABLE 1-B**

Company Hickory Creek Oil Company Lease VILMER-3 Well No. HCO-52

÷24=12.6

| 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. | | |
| 1 | 170.5 | 22.0 | 61 | 16 | 77 | 1041 | 81. | 0.6 | 0.6 | 625 | 48.60 |
| 2 | 171.5 | 22.8 | 61 | 19 | 80 | 1079 | 317. | 1.0 | 1.6 | 1079 | 317.00 |
| 3 | 172.6 | 23.1 | 57 | 15 | 72 | 1022 | 97. | 1.0 | 2.6 | 1022 | 97.00 |
| 4 | 173.5 | 24.1 | 61 | 12 | 73 | 1141 | 166. | 1.0 | 3.6 | 1141 | 166.00 |
| 5 | 174.5 | 23.6 | 39 | 20 | 59 | 714 | 53. | 1.0 | 4.6 | 714 | 53.00 |
| 6 | 175.7 | 26.1 | 61 | 18 | 79 | 1235 | 149. | 1.0 | 5.6 | 1235 | 149.00 |
| 7 | 176.5 | 22.9 | 56 | 20 | 76 | 995 | 44. | 1.0 | 6.6 | 995 | 44.00 |
| 8 | 177.6 | 25.1 | 52 | 16 | 68 | 1013 | 31. | 1.0 | 7.6 | 1013 | 36.00 |
| 9 | 178.7 | 22.1 | 53 | 21 | 74 | 909 | 72. | 1.0 | 8.6 | 909 | 72.00 |
| 10 | 179.5 | 23.6 | 56 | 15 | 71 | 1025 | 78. | 1.3 | 9.9 | 1333 | 101.40 |
| 11 | 180.5 | 23.4 | 56 | [illegible] | 73 | 1017 | 13. | 0.6 | 10.5 | 610 | 7.80 |
| 12 | 181.5 | 16.7 SHALEY | 40 | [illegible] MOBILE | 84 | 518 | 6.5 | 1.0 | 11.5 | 518 | 6.50 |
| 13 | 182.5 | 21.5 | 57 | 18 | 75 | 951 | 24. | 1.2 | 12.7 | 1141 | 28.80 |
| 14 | 183.5 | 21.7 | 50 | 23 | 73 | 842 | 93. | 0.9 | 13.6 | 758 | 83.70 |
| 15 | 184.5 | 23.7 | 53 | 14 | 67 | 975 | 187. | 1.0 | 14.6 | 975 | 187.00 |
| 16 | 185.4 | 24.3 | 48 | 20 | 68 | 905 | 100. | 1.0 | 15.6 | 905 | 100.00 |
| 17 | 186.5 | 19.9 | 39 | [illegible] | 67 | 602 | 25. | 1.0 | 16.6 | 602 | 25.00 |
| 18 | 187.8 | 21.6 | 50 | [illegible] | 75 | 838 | 12. | 1.0 | 17.6 | 838 | 12.00 |
| 19 | 188.5 | 23.5 | 42 | [illegible] | 70 | 766 | 181. | 1.0 | 18.6 | 766 | 181.00 |
| 20 | 189.5 | 20.0 SHALEY | 56 | [illegible] | 90 | 869 | 110. | 1.0 | 19.6 | 869 | 110.00 |
| 21 | 190.5 | 24.3 | 45 | 23 | 68 | 848 | 161. | 1.0 | 20.6 | 848 | 161.00 |
| 22 | 191.5 | 23.7 | 47 | 24 | 71 | 864 | 21. | 1.0 | 21.6 | 864 | 21.00 |
| 23 | 192.5 | 21.6 | 44 | 30 | 74 | 737 | 9.1 | 1.3 | 22.9 | 958 | 11.83 |
| 24 | 193.5 | 24.3 | 48 | 30 | 78 | 905 | 32. | 0.7 | 23.6 | 634 | 22.40 |
| 25 | 194.5 | 19.6 | 55 | 36 | 91 | 836 | 9.5 | 1.0 | 24.6 | 836 | 9.50 |
| 26 | 195.5 | 14.6 | 46 | 39 | 85 | 521 | 6.4 | 1.0 | 25.6 | 521 | 6.40 |
| 27 | 196.5 | 14.8 | 62 | 32 | 94 | 712 | 90. | 1.0 | 26.6 | 712 | 90.00 |

1-17.6 = 82.4

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**RESULTS OF SATURATION & PERMEABILITY TESTS**

**TABLE 1-B**

Company Hickory Creek Oil Company Lease VILMER-3 Well No. HCO-52

7811.4 918.5 1241 3711.5

| 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. | | |
| 28 | 197.6 | 23.0 | 42 | 37 | 79 | 749 | 125. | 1.0 | 27.6 | 749 | 125.00 |
| 29 | 198.5 | 24.4 | 59 | 24 | 83 | 1117 | 128. | 1.0 | 28.6 | 1117 | 128.00 |
| 30 | 199.5 | 24.6 | 37 | 21 | 58 | 706 | 86. | 1.0 | 29.6 | 706 | 86.00 |
| 31 | 200.5 | 22.9 | 32 | 27 | 59 | 569 | 46. | 1.0 | 30.6 | 569 | 46.00 |
| 32 | 201.5 | 25.8 | 38 | 40 | 78 | 761 | 207. | 1.0 | 31.6 | 761 | 207.00 |
| 33 | 202.5 | 23.9 | 37 | 55 | 92 | 686 | 199. | 1.3 | 32.9 | 892 | 258.70 |
| 34 | 203.5 | 20.2 | 34 | 51 | 85 | 533 | 113. | 0.7 | 33.6 | 373 | 79.10 |
| 35 | 204.5 | 24.3 | 36 | 44 | 80 | 679 | 181. | 1.0 | 34.6 | 679 | 181.00 |
| 36 | 205.5 | 23.0 | 33 | 54 | 87 | 589 | 121. | 1.0 | 35.6 | 589 | 121.00 |
| 37 | 206.5 | 22.4 | 34 | 57 | 91 | 591 | 60. | 1.0 | 36.6 | 591 | 60.00 |
| 38 | 207.5 | 23.4 | 38 | 43 | 81 | 690 | 34. | 1.0 | 37.6 | 690 | 34.00 |
| 39 | 208.5 | 22.6 | 33 | 49 | 82 | 579 | 84. | 1.0 | 38.6 | 579 | 84.00 |
| 40 | 209.5 | 22.8 | 37 | 53 | 90 | 655 | 84. | 1.0 | 39.6 | 655 | 84.00 |
| 41 | 210.5 | 20.6 | 36 | 49 | 85 | 575 | 75. | 0.7 | 40.3 | 403 | 52.50 |

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### SUMMARY OF PERMEABILITY & SATURATION TESTS

### TABLE III

Company Hickory Creek Oil Company Lease Vilmer - 3 Well No. HCO-52

| Depth Interval, Feet | Feet of Core Analyzed | Average Permeability, Millidarcys | Permeability Capacity Ft. x Md. |
|---|---|---|---|
| 170.4 - 180.3 | 9.9 | 109.5 | 1084.00 |
| 180.3 - 194.0 | 14.7 | 65.4 | 961.03 |
| 194.0 - 210.7 | 15.7 | 104.6 | 1642.70 |
| 170.4 - 210.7 | 40.3 | 91.5 | 3687.73 |

| 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 |
|---|---|---|---|---|---|---|
| 170.4 - 180.3 | 9.9 | 23.6 | 55.5 | 17.2 | 1017 | 10,066. |
| 180.3 - 194.0 | 14.7 | 21.9 | 48.5 | 26.4 | 825 | 12,122. |
| 194.0 - 210.7 | 15.7 | 22.2 | 39.8 | 42.1 | 674 | 10,586. |
| 170.4 - 210.7 | 40.3 | 22.4 | 46.8 | 30.3 | 813 | 32,774. |

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**RESULTS OF LABORATORY FLOODING TESTS**

**TABLE IV**

Company Hickory Creek Oil Company Lease VILMER-3 Well No. HCO-52

| 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 | 170.5 | 21.5 | 61 | 1017 | 28 | 467 | 33 | 61 | 550 | 238 | 12.18 | 10 |
| 2 | 171.5 | 22.9 | 61 | 1084 | 24 | 426 | 37 | 58 | 658 | 462 | 48.22 | 10 |
| 3 | 172.6 | 23.2 | 57 | 1026 | 30 | 548 | 27 | 64 | 486 | 136 | 16.99 | 10 |
| 4 | 173.5 | 24.2 | 61 | 1145 | 28 | 526 | 33 | 62 | 619 | 589 | 60.59 | 10 |
| 5 | 174.5 | 23.4 | 39 | 708 | 6 | 109 | 33 | 45 | 599 | 150 | 2.25 | 20 |
| 6 | 175.7 | 26.0 | 61 | 1230 | 20 | 403 | 41 | 54 | 827 | 408 | 43.72 | 15 |
| 7 | 176.5 | 23.4 | 56 | 1017 | 20 | 363 | 36 | 57 | 654 | 320 | 19.30 | 15 |
| 8 | 177.6 | 25.0 | 52 | 1009 | 19 | 369 | 33 | 61 | 640 | 247 | 10.49 | 15 |
| 9 | 178.7 | 22.5 | 53 | 925 | 18 | 314 | 35 | 59 | 611 | 291 | 9.00 | 15 |
| 10 | 179.5 | 23.4 | 56 | 1017 | 24 | 436 | 32 | 64 | 581 | 687 | 6.90 | 10 |
| 11 | 180.5 | 23.0 | 56 | 999 | 0 | 0 | 56 | 39 | 999 | 0 | Imp. | - |
| 12 | 181.5 | 17.1 | 40 | 531 | 0 | 0 | 40 | 50 | 531 | 0 | Imp. | - |
| 13 | 182.5 | 21.0 | 57 | 929 | 19 | 310 | 38 | 55 | 619 | 61 | 1.35 | 25 |
| 14 | 183.5 | 22.0 | 50 | 853 | 18 | 307 | 32 | 58 | 546 | 158 | 7.72 | 20 |
| 15 | 184.5 | 23.3 | 53 | 958 | 11 | 199 | 42 | 51 | 759 | 224 | 13.12 | 15 |
| 16 | 185.4 | 23.9 | 48 | 890 | 3 | 56 | 45 | 46 | 834 | 100 | 2.10 | 30 |
| 17 | 186.5 | 19.8 | 39 | 599 | 0 | 0 | 39 | 50 | 599 | 10 | 0.30 | 35 |
| 18 | 187.8 | 21.1 | 50 | 818 | 7 | 115 | 43 | 44 | 703 | 15 | 0.37 | 35 |
| 19 | 188.5 | 24.0 | 42 | 782 | 4 | 74 | 38 | 57 | 708 | 175 | 10.12 | 20 |
| 20 | 189.5 | 20.5 | 56 | 891 | 14 | 223 | 42 | 54 | 668 | 394 | 5.92 | 25 |
| 21 | 190.5 | 24.7 | 45 | 862 | 6 | 115 | 39 | 47 | 747 | 125 | 15.62 | 15 |
| 22 | 191.5 | 24.2 | 47 | 882 | 4 | 75 | 43 | 54 | 807 | 116 | 2.02 | 30 |
| 23 | 192.5 | 22.0 | 44 | 751 | 3 | 51 | 41 | 53 | 700 | 313 | 6.15 | 20 |
| 24 | 193.5 | 23.9 | 48 | 890 | 2 | 37 | 46 | 50 | 853 | 126 | 2.40 | 30 |
| 25 | 194.5 | 20.0 | 55 | 853 | 11 | 171 | 44 | 52 | 682 | 23 | 0.60 | 30 |
| 26 | 195.5 | 14.9 | 45 | 520 | 0 | 0 | 45 | 42 | 520 | 0 | Imp. | - |
| 27 | 196.5 | 15.1 | 62 | 726 | 0 | 0 | 62 | 36 | 726 | 140 | 17.49 | 20 |
| 28 | 197.6 | 22.8 | 42 | 743 | 2 | 35 | 40 | 54 | 708 | 235 | 11.24 | 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 Vilmer -3 Well No. HCO-52

| Sample No. | Depth, Feet | Effective Porosity Percent | Original Oil Saturation | | Oil Recovery | | 15% Residual Saturation | | | Volume of Water Recovered cc* | 481.03 Effective Permeability Millidarcys** | Initial Fluid Production Pressure Lbs./Sq./In. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | Bbls./A. Ft. | % | Bbls./A. Ft. | % Oil | % Water | Bbls./A. Ft. | | | |
| 29 | 198.5 | 24.5 | 59 | 1121 | 0 | 0 | 59 | 33 | 1121 | 228 | 3.75 | 20 |
| 30 | 199.5 | 24.4 | 38 | 719 | 0 | 0 | 38 | 40 | 719 | 0 | Imp. | - |
| 31 | 200.5 | 23.0 | 32 | 571 | 0 | 0 | 32 | 39 | 571 | 0 | Imp. | - |
| 32 | 201.5 | 26.1 | 38 | 769 | 2 | 40 | 36 | 53 | 729 | 108 | 16.19 | 10 |
| 33 | 202.5 | 24.4 | 37 | 700 | 0 | 0 | 37 | 54 | 700 | 403 | 34.23 | 10 |
| 34 | 203.5 | 20.6 | 34 | 543 | 0 | 0 | 34 | 49 | 543 | 35 | 0.52 | 20 |
| 35 | 204.5 | 24.7 | 36 | 690 | 0 | 0 | 36 | 55 | 690 | 170 | 15.37 | 10 |
| 36 | 205.5 | 23.0 | 33 | 589 | 0 | 0 | 33 | 66 | 589 | 260 | 4.08 | 10 |
| 37 | 206.5 | 22.7 | 34 | 599 | 0 | 0 | 34 | 60 | 599 | 192 | 16.86 | 10 |
| 38 | 207.5 | 23.4 | 38 | 690 | 2 | 36 | 36 | 61 | 654 | 209 | 3.33 | 20 |
| 39 | 208.5 | 22.1 | 33 | 566 | 0 | 0 | 33 | 66 | 566 | 557 | 8.25 | 10 |
| 40 | 209.5 | 23.3 | 37 | 669 | 0 | 0 | 37 | 60 | 669 | 458 | 42.47 | 10 |
| 41 | 210.5 | 21.1 | 36 | 589 | 0 | 0 | 36 | 60 | 589 | 262 | 9.82 | 20 |

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-52

| Depth Interval, Feet | 170.4 - 180.3 | 180.3 - 194.0 | 194.0 - 210.7 | 170.4 - 210.7 |
|---|---|---|---|---|
| Feet of Core Analyzed | 9.9 | 12.1 | 3.0 | 25.0 |
| Average Percent Porosity | 23.6 | 22.5 | 24.1 | 23.1 |
| Average Percent Original Oil Saturation | 55.5 | 49.6 | 39.3 | 50.7 |
| Average Percent Oil Recovery | 21.5 | 8.6 | 2.0 | 12.9 |
| Average Percent Residual Oil Saturation | 34.0 | 41.0 | 37.3 | 37.8 |
| Average Percent Residual Water Saturation | 58.6 | 51.8 | 56.0 | 55.0 |
| Average Percent Total Residual Fluid Saturation | 92.6 | 92.8 | 93.3 | 92.8 |
| Average Original Oil Content, Bbls./A. Ft. | 1,018. | 861. | 734. | 906. |
| Average Oil Recovery, Bbls./A. Ft. | 394. | 146. | 37. | 231. |
| Average Residual Oil Content, Bbls./A. Ft. | 624. | 715. | 697. | 677. |
| Total Original Oil Content, Bbls./Acre | 10,084. | 10,418. | 2,202. | 22,704. |
| Total Oil Recovery, Bbls./Acre | 3,905. | 1,769. | 111. | 5,785. |
| Total Residual Oil Content, Bbls./Acre | 6,179. | 8,649. | 2,091. | 16,919. |
| Average Effective Permeability, Millidarcys | 22.91 | 5.63 | 10.25 | 12.99 |
| Average Initial Fluid Production Pressure, p.s.i. | 13.0 | 24.6 | 15.0 | 18.8 |

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