

OILFIELD RESEARCH LABORATORIES

813 EAST SIXTH
OKMULGEE, OKLAHOMA
PHONE: 4444

- REGISTERED ENGINEERS -

Chanute, Kansas

536 N. HIGHLAND
CHANUTE, KANSAS
PHONE: 728

May 31, 1961

Aylward & Willis
First National Bank Building
Wichita, Kansas

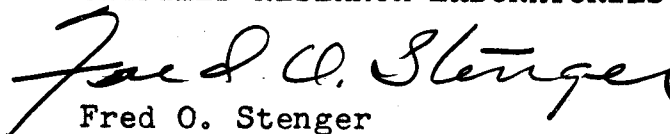
Gentlemen:

Enclosed herewith is the report of the analysis of the Cable Tool core taken from the Stitt Lease, Well No. 5, Neosho County, Kansas, and submitted to our laboratory on May 24, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES



Fred O. Stenger

FOS:rf

5 c.

This core was taken with a cable tool core barrel using fresh water as the coring fluid. The well was drilled in semi-virgin territory. The core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

| <u>Depth Interval,</u> | <u>Description</u> |
|------------------------|--------------------|
| <u>Feet</u> | |

| | |
|---------------|--------------------------------------------|
| 878.5 - 886.0 | - Brownish gray slightly shaley sandstone. |
|---------------|--------------------------------------------|

| | |
|---------------|------------------------------------------|
| 886.0 - 889.0 | - Light brown slightly shaley sandstone. |
|---------------|------------------------------------------|

| | |
|---------------|-------------------------------------------|
| 889.0 - 892.0 | - Light brown laminated shaley sandstone. |
|---------------|-------------------------------------------|

| | |
|---------------|------------------------------------------|
| 892.0 - 902.0 | - Light brown slightly shaley sandstone. |
|---------------|------------------------------------------|

| | |
|---------------|----------|
| 902.0 - 904.0 | - Shale. |
|---------------|----------|

Coring was started at a depth of 878.5 feet in slightly shaley sandstone and completed at 904.0 feet in shale. This core shows a total of 23.5 feet of sandstone. For the most part, the pay is made up of light brown, slightly shaley 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 is 62.4, 33.0 and 312.2 millidarcys respectively; while that of the pay sand is 207.8; the overall average being 161.1 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather irregular permeability profile. The permeability of the sand varies from 10 to a maximum of 780 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly low weighted average percent oil saturation, namely, 23.7. The weighted average percent oil satura-

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tion of the upper, middle and lower sections is 7.0, 26.0 and 34.8 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 62.5, 49.9 and 51.2 respectively; while that of the pay sand is 50.7, the overall average being 54.5 (See Table III). This gives an overall weighted average total fluid saturation of 78.2 percent. This low total fluid saturation indicates considerable fluid was lost during coring part of which was probably oil.

The weighted average oil content of the upper, middle and lower sections is 110,364 and 576 barrels per acre foot respectively; while that of the pay sand is 496, the overall average being 373. The total oil content, as shown by this core, is 8,764 barrels per acre of which 7,942 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The lower portion of the sand in this core responded well to laboratory flooding tests, as a total recovery of 1,995 barrels of oil per acre was obtained from 16.0 feet of sand. The weighted average percent oil saturation was reduced from 31.5 to 23.7, or represents an average recovery of 7.8 percent. The weighted average effective permeability of the samples is 20.49 millidarcys, while the average initial fluid production pressure is 12.5 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 24 samples tested, all produced water and 16 oil. This indicates that approximately 67 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a wide variation in effective permeability to water.

CONCLUSION

Based on the results of the laboratory tests, it appears that an efficient water-flood in the vicinity of this well should recover approx-

imately 3,100 barrels of oil per acre. This represents an average recovery of 194 barrels per acre foot from the 16.0 feet of floodable pay sand analyzed in this core. The above recovery values were calculated using the following data and assumptions:

| | |
|--------------------------------------|------|
| Original formation volume factor | 1.08 |
| Present formation volume factor | 1.02 |
| Reservoir water saturation | 40.0 |
| Primary recovery, estimated, percent | 10.0 |
| Average porosity, percent | 20.2 |
| Abandonment oil saturation, percent | 23.7 |
| Performance factor, percent | 55.0 |
| Net floodable pay sand, feet | 16.0 |

This core indicates a reservoir having a rather clean sand section with a fair oil saturation, a moderate water saturation and good effective permeability to water. No difficulty should be encountered in obtaining satisfactory injection rates.

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Aylward & WillisLease StittWell No. 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. | | |
| 1 | 878.5 | 22.2 | 3 | 64 | 67 | 52 | 45. | 0.5 | 26 | 22.50 | |
| 2 | 879.5 | 21.2 | 11 | 59 | 70 | 181 | 88. | 1.0 | 181 | 88.00 | |
| 3 | 880.5 | 22.4 | 4 | 62 | 66 | 69 | 93. | 1.0 | 69 | 93.00 | |
| 4 | 881.5 | 21.9 | 4 | 70 | 74 | 68 | 88. | 1.0 | 68 | 88.00 | |
| 5 | 882.5 | 19.1 | 3 | 61 | 64 | 44 | 27. | 1.0 | 44 | 27.00 | |
| 6 | 883.5 | 19.3 | 9 | 65 | 74 | 135 | 13. | 1.0 | 135 | 13.00 | |
| 7 | 884.5 | 18.6 | 11 | 59 | 70 | 159 | 70. | 1.0 | 159 | 70.00 | |
| 8 | 885.5 | 20.0 | 9 | 61 | 70 | 140 | 66. | 1.0 | 140 | 66.00 | |
| 9 | 886.5 | 19.7 | 23 | 49 | 72 | 352 | 22. | 1.0 | 352 | 22.00 | |
| 10 | 887.5 | 19.6 | 29 | 44 | 73 | 441 | 67. | 1.0 | 441 | 67.00 | |
| 11 | 888.5 | 20.2 | 20 | 49 | 69 | 314 | 29. | 1.0 | 314 | 29.00 | |
| 12 | 889.5 | 17.0 | 24 | 54 | 78 | 316 | 10. | 1.0 | 316 | 10.00 | |
| 13 | 890.5 | 16.7 | 28 | 45 | 73 | 363 | 42. | 1.0 | 363 | 42.00 | |
| 14 | 891.5 | 16.0 | 32 | 58 | 90 | 397 | 28. | 1.0 | 397 | 28.00 | |
| 15 | 892.5 | 19.3 | 34 | 56 | 90 | 509 | 90. | 1.0 | 509 | 90.00 | |
| 16 | 893.5 | 21.3 | 26 | 47 | 73 | 430 | 411. | 1.0 | 430 | 411.00 | |
| 17 | 894.5 | 21.6 | 29 | 53 | 82 | 486 | 395. | 1.0 | 486 | 395.00 | |
| 18 | 895.5 | 21.3 | 26 | 47 | -73 | 430 | 68. | 1.0 | 430 | 68.00 | |
| 19 | 896.5 | 21.7 | 30 | 50 | 80 | 505 | 372. | 1.0 | 505 | 372.00 | |
| 20 | 897.5 | 21.0 | 44 | 44 | 88 | 717 | 177. | 1.0 | 717 | 177.00 | |
| 21 | 898.5 | 21.0 | 49 | 48 | 97 | 799 | 207. | 1.0 | 799 | 207.00 | |
| 22 | 899.5 | 21.8 | 46 | 47 | 93 | 778 | 357. | 1.0 | 778 | 357.00 | |
| 23 | 900.5 | 21.8 | 38 | 55 | 93 | 642 | 265. | 1.0 | 642 | 265.00 | |
| 24 | 901.5 | 23.0 | 26 | 65 | 91 | 463 | 780. | 1.0 | 463 | 780.00 | |

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

| Company | | Lease | | Well No. | | |
|-------------------------|--------------------------|--------------------------------|--------------------------------------|-----------------------------------------|---------------------------------------|-----------------------------------|
| Aylward & Willis | | Stitt | | 5 | | |
| 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 Bbl./Acre |
| 878.5 - 886.0 | 7.5 | 20.4 | 7.0 | 62.5 | 110 | 822 |
| 886.0 - 892.0 | 6.0 | 18.2 | 26.0 | 49.9 | 364 | 2,183 |
| 892.0 - 902.0 | 10.0 | 21.4 | 34.8 | 51.2 | 576 | 5,759 |
| 878.5 - 902.0 | 23.5 | 20.3 | 23.7 | 54.5 | 373 | 8,764 |
| Depth Interval, Feet | Feet of Core Analyzed | Average Percent Porosity | Average Percent Oil Saturation | Average Permeability, Millidarcys | Permeability Capacity Ft. x Md. | |
| 878.5 - 886.0 | 7.5 | | | 62.4 | 467.50 | |
| 886.0 - 892.0 | 6.0 | | | 33.0 | 198.00 | |
| 892.0 - 902.0 | 10.0 | | | 312.2 | 3122.00 | |
| 878.5 - 902.0 | 23.5 | | | 161.1 | 3787.50 | |

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Well No. 5

Company Aylward & Willis

Lease Stitt

| 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 | | | |
| 1 | 878.6 | 21.8 | 5 | 85 | 0 | 0 | 5 | 79 | 223 | 15.80 | 5 |
| 2 | 879.5 | 21.0 | 14 | 228 | 0 | 0 | 14 | 71 | 219 | 29.20 | 5 |
| 3 | 880.5 | 22.2 | 6 | 103 | 0 | 0 | 6 | 88 | 305 | 14.80 | 10 |
| 4 | 881.5 | 21.4 | 7 | 116 | 0 | 0 | 7 | 77 | 306 | 14.70 | 5 |
| 5 | 882.5 | 19.4 | 3 | 451 | 0 | 0 | 3 | 82 | 231 | 9.15 | 5 |
| 6 | 883.5 | 19.6 | 11 | 167 | 0 | 0 | 11 | 83 | 283 | 33.60 | 5 |
| 7 | 884.5 | 18.9 | 9 | 132 | 0 | 0 | 9 | 88 | 265 | 27.60 | 5 |
| 8 | 885.5 | 19.7 | 11 | 168 | 0 | 0 | 11 | 80 | 174 | 23.56 | 5 |
| 9 | 886.5 | 20.0 | 23 | 358 | 3 | 47 | 20 | 65 | 252 | 10.82 | 5 |
| 10 | 887.5 | 19.7 | 29 | 444 | 2 | 31 | 27 | 67 | 253 | 12.79 | 15 |
| 11 | 888.5 | 19.9 | 20 | 309 | 2 | 31 | 18 | 75 | 387 | 9.51 | 10 |
| 12 | 889.5 | 16.7 | 24 | 311 | 3 | 39 | 21 | 60 | 93 | 2.32 | 15 |
| 13 | 890.5 | 16.7 | 28 | 362 | 8 | 104 | 20 | 73 | 58 | 2.54 | 20 |
| 14 | 891.5 | 16.5 | 32 | 410 | 4 | 51 | 28 | 57 | 10 | 0.415 | 40 |
| 15 | 892.5 | 19.1 | 34 | 504 | 8 | 119 | 19 | 68 | 242 | 10.21 | 15 |
| 16 | 893.5 | 21.6 | 26 | 435 | 7 | 117 | 21 | 76 | 293 | 40.10 | 10 |
| 17 | 894.5 | 21.7 | 29 | 489 | 8 | 135 | 21 | 77 | 142 | 35.40 | 10 |
| 18 | 895.5 | 21.1 | 26 | 426 | 5 | 82 | 21 | 70 | 109 | 25.00 | 10 |
| 19 | 896.5 | 21.5 | 30 | 500 | 6 | 100 | 24 | 73 | 231 | 29.00 | 10 |
| 20 | 897.5 | 20.7 | 44 | 706 | 15 | 241 | 29 | 68 | 153 | 3.78 | 15 |
| 21 | 898.5 | 20.7 | 49 | 787 | 21 | 338 | 28 | 69 | 469 | 17.83 | 5 |
| 22 | 899.5 | 21.7 | 46 | 775 | 17 | 286 | 29 | 67 | 311 | 42.50 | 5 |
| 23 | 900.5 | 21.5 | 38 | 634 | 11 | 184 | 27 | 70 | 214 | 30.38 | 5 |
| 24 | 901.5 | 23.3 | 26 | 470 | 5 | 90 | 21 | 67 | 219 | 55.40 | 5 |

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 | Lease | Stitt | Well No. |
|---------------------------------------------------|---------------|---------------|---------------|
| Aylward & Willis | 886.0 - 892.0 | 892.0 - 902.0 | 886.0 - 902.0 |
| | 6.0 | 10.0 | 5 |
| Feet of Core Analyzed | 18.3 | 21.3 | 16.0 |
| Average Percent Porosity | 26.1 | 34.8 | 20.2 |
| Average Percent Original Oil Saturation | 3.7 | 10.3 | 31.5 |
| Average Percent Oil Recovery | 22.4 | 24.5 | 7.8 |
| Average Percent Residual Oil Saturation | 66.1 | 70.5 | 23.7 |
| Average Percent Residual Water Saturation | 88.5 | 95.0 | 69.0 |
| Average Percent Total Residual Fluid Saturation | 366. | 572. | 92.7 |
| Average Original Oil Content, Bbls./A. Ft. | 51. | 169. | 495. |
| Average Oil Recovery, Bbls./A. Ft. | 315. | 403. | 125. |
| Average Residual Oil Content, Bbls./A. Ft. | 2,194. | 5,726. | 370. |
| Total Original Oil Content, Bbls./Acre | 303. | 1,692. | 7,920. |
| Total Oil Recovery, Bbls./Acre | 1,891. | 4,034. | 1,995. |
| Total Residual Oil Content, Bbls./Acre | 6.40 | 28.96 | 5,925. |
| Average Effective Permeability, Millidarcys | 18.3 | 9.0 | 20.49 |
| Average Initial Fluid Production Pressure, p.s.i. | | | 12.5 |

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