OILFIELD RESEARCH LABORATORIES
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Chanute, Kansas

September 10, 1965

Triple "A" Drilling Company
7802 East Indianapolis
Wichita, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Pray Lease, Well No. 1, Elk County, Kansas, and submitted to our laboratory on September 8, 1965.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

Benjamin R. Pearman

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# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

Company Triple "A" Drilling Co. Lease Pray Well No. 1

Location SW SW SW NE

Section 16 Twp. 31S Rge. 13E County Elk State Kansas

| | |
|---|---|
| Name of Sand | Wayside |
| Top of Core | 593.0 |
| Bottom of Core | 602.0 |
| Top of Sand (Analyzed) | 593.0 |
| Bottom of Sand (Analyzed) | 602.0 |
| Total Feet of Permeable Sand | 9.0 |
| Total Feet of Floodable Sand | 6.0 |

Distribution of Permeable Sand:

| Permeability Range Millidarcys | Feet | Cum. Ft. |
|---|---|---|
| 5 - 10 | 3.0 | 3.0 |
| 10 - 20 | 4.0 | 7.0 |
| 20 & above | 2.0 | 9.0 |

| | |
|---|---|
| Average Permeability Millidarcys | 15.2 |
| Average Percent Porosity | 19.8 |
| Average Percent Oil Saturation | 27.9 |
| Average Percent Water Saturation | 50.5 |
| Average Oil Content, Bbls./A. Ft. | 428. |
| Total Oil Content, Bbls./Acre | 3,848. |
| Average Percent Oil Recovery by Laboratory Flooding Tests | 5.5 |
| Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. | 86. |
| Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre | 514. |
| Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary) | 1,510. |
| Packer Setting, Feet | |
| Viscosity, Centipoises @ | |
| A. P. I. Gravity, degrees @ 60 °F | |
| Elevation, Feet | |

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in plastic bags by a representative of the client. The well was drilled in non-virgin territory.

## FORMATION CORED

The detailed log of the formation cored is as follows:

| Depth Interval, Feet | Description |
|---|---|
| 593.0 - 601.0 | Light brown, laminated, shaly sandstone. |
| 601.0 - 602.0 | Gray, laminated, shaly sandstone. |

Coring was started at a depth of 593.0 feet in laminated, shaly sandstone and completed at 602.0 feet. This core shows a total of 9.0 feet of sandstone. For the most part, the pay is made up of light brown, laminated, shaly sandstone.

## PERMEABILITY

The weighted average permeability of the core is 15.2 millidarcys (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a fairly regular permeability profile. The permeability of the sand varies from 5.6 to a maximum of 34. millidarcys.

## PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 27.9. The weighted average percent water saturation is 50.5 (See Table III). This gives an overall weighted average total fluid saturation of 78.4 percent. This low total fluid

saturation indicates some fluid was lost during coring most of which was probably oil.

The weighted average oil content of the core is 428 barrels per acre foot. The total oil content, as shown by this core, is 3,848 barrels per acre of which 2,858 barrels are in the pay sand section (See Table III).

## LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 514 barrels of oil per acre was obtained from 6.0 feet of sand. The weighted average percent oil saturation was reduced from 31.0 to 25.5, or represents an average recovery of 5.5 percent. The weighted average effective permeability of the samples is 0.431 millidarcys, while the average initial fluid production pressure is 35.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 9 samples tested, all produced water and 6 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 fairly uniform effective permeability to water.

## CONCLUSION

The results of the laboratory tests indicate that efficient primary and secondary operations in the vicinity of this well should recover approximately 1,510 barrels of oil per acre or an average of 252 barrels per acre foot from the 6.0 feet of pay sand analyzed

in this core. These recovery values were calculated using the following data and assumptions:

| | |
|---|---|
| Original formation volume factor | 1.04 |
| Present formation volume factor | 1.02 |
| Reservoir water saturation, percent | 40.0 |
| Average porosity, percent | 19.8 |
| Oil saturation after flooding, percent | 25.5 |
| Performance factor, percent | 50.0 |
| Net floodable pay sand, feet | 6.0 |

This core shows a pay sand section having a good oil saturation, a moderate water saturation and a fairly uniform effective permeability to water. Any primary oil already recovered from the area represented by this core should be subtracted from the foregoing recovery values. The secondary recovery values were calculated assuming that satisfactory injection rates will be maintained throughout the flood life of the property.

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### RESULTS OF SATURATION & PERMEABILITY TESTS

### TABLE 1-B

Company Triple "A" Drilling Co. Lease Pray Well No. 1

| 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 | 593.5 | 17.7 | 29 | 58 | 87 | 397 | 11. | 1.0 | 1.0 | 397 | 11.00 |
| 2 | 594.5 | 20.4 | 35 | 52 | 87 | 554 | 28. | 1.0 | 2.0 | 554 | 28.00 |
| 3 | 595.5 | 19.2 | 24 | 51 | 75 | 357 | 12. | 1.0 | 3.0 | 357 | 12.00 |
| 4 | 596.5 | 21.4 | 31 | 40 | 71 | 514 | 34. | 1.0 | 4.0 | 514 | 34.00 |
| 5 | 597.5 | 19.8 | 29 | 48 | 77 | 445 | 7.6 | 1.0 | 5.0 | 445 | 7.60 |
| 6 | 598.5 | 18.5 | 28 | 45 | 73 | 401 | 10. | 1.0 | 6.0 | 401 | 10.00 |
| 7 | 599.5 | 20.8 | 34 | 41 | 75 | 549 | 12. | 1.0 | 7.0 | 549 | 12.00 |
| 8 | 600.5 | 21.3 | 17 | 57 | 74 | 281 | 16. | 1.0 | 8.0 | 281 | 16.00 |
| 9 | 601.5 | 18.8 | 24 | 62 | 86 | 350 | 5.6 | 1.0 | 9.0 | 350 | 5.60 |
| | | | | | | | | Total- | --------- | -3,848 | |

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**SUMMARY OF PERMEABILITY & SATURATION TESTS**

**TABLE III**

Company Triple "A" Drilling Company Lease Pray Well No. 1

| Depth Interval, Feet | Feet of Core Analyzed | Average Permeability, Millidarcys | Permeability Capacity Ft. x Md. |
|---|---|---|---|
| 593.0 - 602.0 | 9.0 | 15.2 | 136.20 |

| 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 |
|---|---|---|---|---|---|---|
| 593.0 - 602.0 | 9.0 | 19.8 | 27.9 | 50.5 | 428 | 3,848 |

## Oilfield Research Laboratories

### RESULTS OF LABORATORY FLOODING TESTS

### TABLE IV

Company Triple "A" Drilling Co. Lease Pray Well No. 1

| 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 | 593.5 | 17.2 | 29 | 386 | 4 | 53 | 25 | 67 | 333 | 7 | 0.167 | 50 |
| 2 | 594.5 | 20.7 | 35 | 561 | 7 | 112 | 28 | 61 | 449 | 14 | 0.250 | 40 |
| 3 | 595.5 | 19.5 | 25 | 378 | 0 | 0 | 25 | 61 | 378 | 39 | 0.666 | 20 |
| 4 | 596.5 | 21.0 | 31 | 504 | 7 | 114 | 24 | 59 | 390 | 51 | 0.916 | 20 |
| 5 | 597.5 | 19.8 | 29 | 445 | 3 | 46 | 26 | 62 | 399 | 20 | 0.416 | 30 |
| 6 | 598.5 | 18.7 | 28 | 406 | 4 | 58 | 24 | 67 | 348 | 22 | 0.416 | 40 |
| 7 | 599.5 | 21.1 | 34 | 556 | 8 | 131 | 26 | 59 | 425 | 25 | 0.416 | 30 |
| 8 | 600.5 | 21.5 | 18 | 300 | 0 | 0 | 18 | 64 | 300 | 36 | 0.666 | 40 |
| 9 | 601.5 | 19.0 | 25 | 368 | 0 | 0 | 25 | 68 | 368 | 25 | 0.416 | 40 |

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 Triple "A" Drilling Company Lease Pray Well No. 1

| | |
|---|---|
| Depth Interval, Feet | 593.0 - 602.0 |
| Feet of Core Analyzed | 6.0 |
| Average Percent Porosity | 19.8 |
| Average Percent Original Oil Saturation | 31.0 |
| Average Percent Oil Recovery | 5.5 |
| Average Percent Residual Oil Saturation | 25.5 |
| Average Percent Residual Water Saturation | 62.5 |
| Average Percent Total Residual Fluid Saturation | 98.0 |
| Average Original Oil Content, Bbls./A. Ft. | 478. |
| Average Oil Recovery, Bbls./A. Ft. | 86. |
| Average Residual Oil Content, Bbls./A. Ft. | 392. |
| Total Original Oil Content, Bbls./Acre | 2,858. |
| Total Oil Recovery, Bbls./Acre | 514. |
| Total Residual Oil Content, Bbls./Acre | 2,344. |
| Average Effective Permeability, Millidarcys | 0.431 |
| Average Initial Fluid Production Pressure, p.s.i. | 35.0 |

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