(10)

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

elevation 1485

Company Jackson Bros. Lease Hawthorne Well No. 9

Location SE NE SE

Section 22 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2505.0
Bottom of Core	2529.0
Top of Pay Sand	2511.6
Bottom of Sand (Analyzed)	2529.0
Total Feet of Permeable Sand	17.0
Total Feet of Floodable Sand	16.2

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	3.6	3.6
10 - 20	4.0	7.6
20 - 30	2.0	9.6
30 - 40	4.4	14.0
40 & above	3.0	17.0

Average Permeability Millidarcys	25.0
Average Percent Porosity	18.7
Average Percent Oil Saturation	23.7
Average Percent Water Saturation	56.6
Average Oil Content, Bbls./A. Ft.	342.
Total Oil Content, Bbls./Acre	6,156.
Average Percent Oil Recovery by Laboratory Flooding Tests	5.2
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	77.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	940.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	4,957.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Jackson Bros. Lease Hawthorne Well No. 9

Depth Interval, Feet	2511.6 - 2519.6	2521.6 - 2529.0	2511.6 - 2529.0
Feet of Core Analyzed	5.4	6.8	12.2
Average Percent Porosity	19.6	19.1	19.3
Average Percent Original Oil Saturation	24.3	25.5	25.0
Average Percent Oil Recovery	4.6	5.6	5.2
Average Percent Residual Oil Saturation	19.7	19.9	19.8
Average Percent Residual Water Saturation	78.0	75.0	76.3
Average Percent Total Residual Fluid Saturation	97.7	94.9	96.1
Average Original Oil Content, Bbls./A. Ft.	370.	377.	374.
Average Oil Recovery, Bbls./A. Ft.	71.	82.	77.
Average Residual Oil Content, Bbls./A. Ft.	299.	295.	297.
Total Original Oil Content, Bbls./Acre	1,997.	2,566.	4,563.
Total Oil Recovery, Bbls./Acre	381.	559.	940.
Total Residual Oil Content, Bbls./Acre	1,616.	2,007.	3,623.
Average Effective Permeability, Millidarcys	2.90	3.32	3.13
Average Initial Fluid Production Pressure, p.s.i.	24.4	21.5	22.8

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

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Bros. Lease Hawthorne Well No. 9

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
2511.0 - 2521.6	58,282		
2521.6 - 2529.0	22,311		
2511.0 - 2529.0	43,642		

Note: ppm — parts per million.

A fresh water mud was used as a circulating fluid in the coring of the sand in this well. The core was sampled and sealed in tin cans by an employee of Oilfield Research Laboratories. This well was drilled in a virgin area.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
2505.0 - 2511.0	Sandy shale.
2511.0 - 2529.0	Light brown, fine grained, slightly shaly sandstone.

Coring was started at a depth of 2505.0 feet in sandy shale and completed at 2529.0 feet in light brown, fine grained, slightly shaly sandstone. This core shows a total of 18.0 feet of sandstone. The pay is made up of fine grained, slightly shaly sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 22.5 and 28.6 millidarcys respectively; the overall average being 25.0 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a somewhat irregular permeability profile. The permeability of the sand varies from 1.0 to a maximum of 55. 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 saturation of the upper and lower sections is 22.5 and 25.4 respectively. The weighted average percent water saturation of the upper and lower sections is 57.2 and 55.8 respectively; the overall average being 56.6 (See Table

III). This gives an overall weighted average total fluid saturation of 70.3 percent. This fairly low total fluid saturation indicates some fluid was lost during coring which was probably oil.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VI and VII. From the data given in these tables and on the coregraph, it is evident that considerable flushing of the sand occurred during coring, especially in the lower part of the sand section.

The weighted average oil content of the upper and lower sections is 322 and 371 barrels per acre foot respectively; the overall average being 342. The total oil content, as shown by this core, is 6,156 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

When taking into consideration that the sand in the core has a fairly low oil saturation, it responded very well to laboratory flooding tests, as a total recovery of 940 barrels of oil per acre was obtained from 12.2 feet of sand. The weighted average percent oil saturation was reduced from 25.0 to 19.8, or represents an average recovery of 5.2 percent. The weighted average effective permeability of the samples is 3.13 millidarcys, while the average initial fluid production pressure is 22.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 18 samples tested, 17 produced water and 13 oil. This indicates that approximately 72 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

From a study of the above data, it is evident that efficient primary

nd water-flood operations in the vicinity of this well, should recover approximately 2,657 and 2,300 barrels of oil per acre respectively. This is equivalent to recoveries of 164 and 142 barrels per acre-foot respectively. The following data was used in calculating the above oil recovery values:

Original formation volume factor	1.24
Irreducible water saturation, percent	38.0
Primary recovery, estimated, percent	None
Present oil saturation, percent	52.5
Average porosity, percent	18.7
Oil saturation after flooding, percent	19.8
Performance factor, percent	55.0
Net floodable pay sand, feet	16.2

This core shows a comparatively clean sand section having a fairly low oil saturation, a high water saturation and a good permeability. The results of chloride tests show that considerable flushing of the sand occurred during the coring operation. This partly accounts for the fairly low oil and high water saturations.

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Bros. Lease Hawthorne Well No. 9

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
2511.0 - 2521.6	10.0	22.5	225.20
2521.6 - 2529.0	7.0	28.6	200.66
2511.0 - 2529.0	17.0	25.0	425.86

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
2511.0 - 2521.6	10.6	18.5	22.5	57.2	322	3,411
2521.6 - 2529.0	7.4	18.9	25.4	55.8	371	2,745
2511.0 - 2529.0	18.0	18.7	23.7	56.6	342	6,156

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

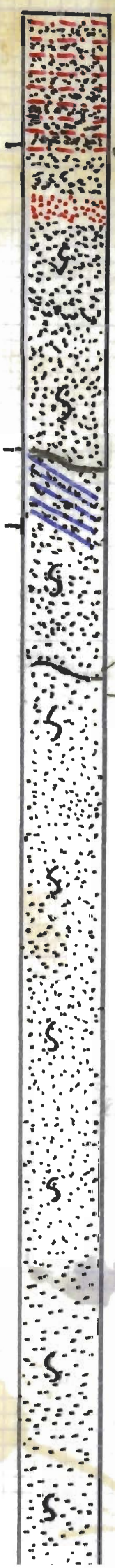
TABLE VI

Company Jackson Bros. **Lease** Hawthorne **Well No.** 9

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	2511.1	114,100			
2	2512.1	37,200			
3	2513.1	35,700			
4	2514.1	77,100			
5	2515.1	66,500			
6	2516.1	39,075			
7	2517.1	48,700			
8	2518.1	92,600			
9	2519.1	47,325			
10	2520.1	35,175			
11	2521.1	61,600			
12	2522.1	64,000			
13	2523.1	21,800			
14	2524.1	17,720			
15	2525.1	14,000			
16	2526.1	13,380			
17	2527.1	15,750			
18	2528.1	10,625			

Note: ppm — parts per million

Hawthorne #9



2510

probably showing some type of ripple or lower plane bed mvmt

horizontally or low-inclined (5°) interbedded vf ss + silt; ||, regular

silt dk greenish gray

vertical crinkly non-techtonic fracture w/ mud-filled silt - root? also

seems to show two directions of transport

← sharp contact

2511

Fe coated grains (concentration) horizontally laminated

2512

Massive ss   Siliceous cement?

coarser than below   sequence #1

2513

Med-inclined bedding || planar, sand coarser than above

2514

may be a little coarser I believe so

small faint propagating ripples

2515

2516

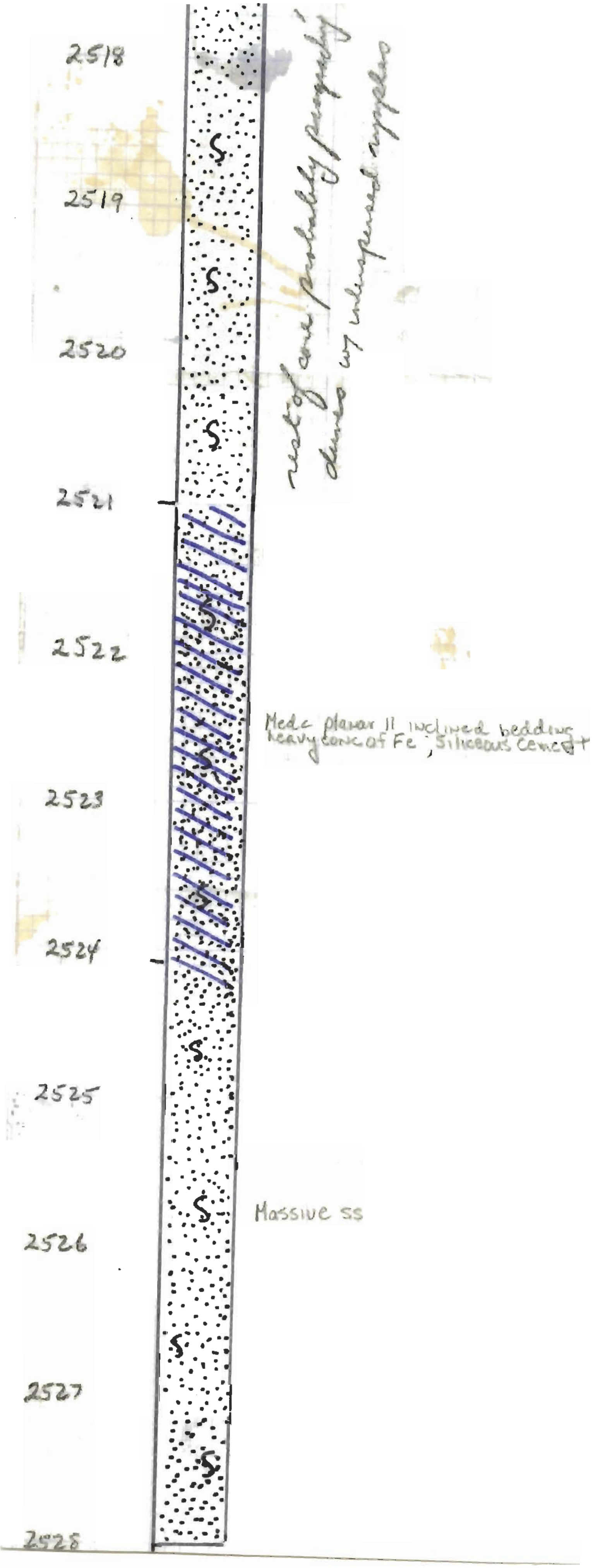
Massive ss

2517

2518

probably propagating interspersed ripples

2519


2518
2519
2520
2521
2522
2523
2524
2525
2526
2527
2528
rest of core probably prograding dunes w/ interspersed ripples
Med c planar II inclined bedding heavy conc of Fe, siliceous cemcnt
Massive ss