● CORE ANALYSIS ● WATER REPRESSURING ENGINEERING ● WATER ANALYSIS ● FLOODING WATER TREATMENT ● SURVEYING

OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

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April 24, 1961

Mr. Mack C. Colt
Iola, Kansas

Dear Sir:

Enclosed herewith is the report of the analysis of the Rotary core samples taken from the Stewart Lease, Well No. 18-A, Allen County, Kansas, and submitted to our laboratory by Mr. Ray Plummer on April 18, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:db

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GENERAL INFORMATION & SUMMARY

Company Mack C. Colt Lease Stewart Well No. 18-A

Location SE¼

Section 22 Twp. 24S Rge. 21E County Allen State Kansas

Name of Sand	Bartlesville
Top of Core	686.7
Bottom of Core	705.0
Top of Sand (Received)	686.7
Bottom of Sand (Received)	705.0
Total Feet of Permeable Sand (Analyzed)	5.6
Total Feet of Floodable Sand (Analyzed)	3.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.

Average Permeability Millidarcys	340.8
Average Percent Porosity	20.0
Average Percent Oil Saturation	30.1
Average Percent Water Saturation	61.4
Average Oil Content, Bbls./A. Ft.	471.
Total Oil Content, Bbls./Acre	2,824.
Average Percent Oil Recovery by Laboratory Flooding Tests	11.7
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	191.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	574.
Total Calculated Oil Recovery, Bbls./Acre	753.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

A water base mud was used as a circulating fluid in the coring of the sand in this well. Only 6 samples from 18.3 feet of core were submitted to our laboratory by a representative of the client for analysis. We assumed that each sample represents one foot of sand.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
686.7 - 687.7	Grayish brown shaley sandstone.
687.7 - 689.3	Core not received.
689.3 - 690.3	Gray shaley sandstone.
690.3 - 695.3	Core not received.
695.3 - 696.3	Gray and brown shaley sandstone.
696.3 - 698.3	Core not received.
698.3 - 699.3	Brown fine grained sandstone.
699.3 - 700.2	Core not received.
700.2 - 701.2	Brown fine grained sandstone.
701.2 - 704.0	Core not received.
704.0 - 705.0	Brown fine grained sandstone.

Coring was started at a depth of 686.7 feet in grayish brown shaley sandstone and completed at 705.0 feet in brown fine grained sandstone. This core shows a total of 6.0 feet of sandstone. For the most part, the pay is made up of brown fine grained sandstone.

PERMEABILITY

The weighted average permeability of the core samples is 340.8 millidarcys (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a irregular permeability profile. The permeability of the sand varies from Imp. to a maximum of 849 millidarcys.

PERCENT SATURATION AND OIL CONTENT

The sand in the samples shows a fairly low weighted average percent oil saturation, namely, 30.1. The weighted average percent water saturation of the samples is 61.4 (See Table III). This gives an overall weighted average total fluid saturation of 91.4 percent. The tests indicate that samples Nos. 1, 2 and 3 were probably taken in gas sand and Nos. 4, 5 and 6 in pay sand.

The weighted average oil content of the samples is 471 barrels per acre foot; while the total oil content, as shown by this core, is 2,824 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The last three samples responded very well to laboratory flooding tests, as a total recovery of 574 barrels of oil per acre was obtained from 3 feet of sand. The weighted average percent oil saturation was reduced from 35.4 to 23.7, or represents an average recovery of 11.7 percent. The weighted average effective permeability of the samples is 20.8 millidarcys, while the average initial fluid production pressure is 11.7 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 6 samples tested, 4 produced water and 3 oil. This indicates that approximately 50 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

On the basis of the above data, it is evident that an efficient waterflood, within the vicinity of this well, will recover approximately 753 barrels of oil per acre or an average of 251 barrels per acre foot from the 3.0 feet of floodable pay sand analyzed. In calculating the above oil recovery value, the following factors and assumptions were employed:

Original formation volume factor	1.06

Present formation volume factor	1.02
Irreducible water saturation, percent	40.0
Primary oil recovery, percent	6.0
Present oil saturation, percent	49.7
Oil saturation after flooding, percent	24.0
Percent porosity	21.7
Performance factor	0.55
Footage per sample	1.0

The samples indicate that the pay sand extends from a depth of approximately 698 to 705 feet. No difficulty should be encountered in forcing the sand to take an ample volume of water.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Mack C. Colt Lease Stewart Well No. 18-A

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	686.8	18.9	41	57	98	601	1.1	1.0	1.0	601	1.10
2	689.8	17.8	16	79	95	221	Imp.	1.0	2.0	221	0.00
3	695.6	10.4	24	66	90	194	-	0.4	2.4	78	-
F-3	695.8	21.4	13	-	-	216	229.	0.6	3.0	130	137.40
4	698.8	24.3	26	65	91	490	849.	1.0	4.0	490	849.00
5	700.7	20.6	35	61	96	560	659.	1.0	5.6	560	659.00
6	704.8	21.3	45	43	88	744	262.	1.0	6.0	744	262.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Mack C. Colt Lease Stewart Well No. 18-A

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
686.7 - 701.2	5.6	340.8	1,908.5

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 Bbls./Acre
686.7 - 701.2	6.0	20.0	30.1	61.4	471	2,824

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Mack C. Colt Lease Stewart Well No. 18-A

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	686.8	18.4	38	543	0	0	38	58	543	0	Imp.	-
2	689.8	18.2	13	184	0	0	13	84	184	0	Imp.	-
3	695.8	21.4	13	216	0	0	13	83	216	1,555	30.35	10
4	698.8	23.4	26	472	4	73	22	76	399	1,648	32.00	10
5	700.7	20.7	35	563	11	177	24	73	386	850	18.00	10
6	704.8	20.9	45	730	20	324	25	70	406	611	15.50	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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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Mack C. Colt Lease Stewart Well No. 18-A

Depth Interval, Feet	698.7 - 705.0
Feet of Core Analyzed	3.0
Average Percent Porosity	21.7
Average Percent Original Oil Saturation	35.4
Average Percent Oil Recovery	11.7
Average Percent Residual Oil Saturation	23.7
Average Percent Residual Water Saturation	73.0
Average Percent Total Residual Fluid Saturation	96.7
Average Original Oil Content, Bbls./A. Ft.	588.
Average Oil Recovery, Bbls./A. Ft.	191.
Average Residual Oil Content, Bbls./A. Ft.	397.
Total Original Oil Content, Bbls./Acre	1,765.
Total Oil Recovery, Bbls./Acre	574.
Total Residual Oil Content, Bbls./Acre	1,191.
Average Effective Permeability, Millidarcys	20.8
Average Initial Fluid Production Pressure, p.s.i.	11.7

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