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April 15, 1959

K & M Oil Company
c/o Paul Burtin
Lebanon, Missouri

Gentlemen:

Enclosed herewith is the report of the analysis of the Cable Tool core taken from the Hibbs "West" Lease, Well No. 3-B, Allen County, Kansas, and submitted to our laboratory on April 7, 1959.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. McElrea
Carl L. McElrea

CLM:cs

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16-26-20E

3-B

Hibbs "West"

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GENERAL INFORMATION & SUMMARY

Company K & M Oil Company Lease Hibbs "West" Well No. 3-B

Location NW $\frac{1}{4}$

Section 16 Twp. 26S Rge. 20E County Allen State Kansas

Name of Sand - - - - - Bartlesville

Top of Core - - - - - 683.0

Bottom of Core - - - - - 702.2

Pay

Top of Sand - - - - - 683.0

Pay

Bottom of Sand - - - - - 696.3

Total Feet of Permeable Sand - - - - - 16.2

Good

Total Feet of Floodable Sand - - - - - 12.0

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

0 - 10	5.0	5.0
10 - 20	2.5	7.5
20 - 30	1.5	9.0
30 - 40	2.9	11.9
40 - 50	2.0	13.9
50 & over	2.3	16.2

Average Permeability Millidarcys - - - - - 26.3

Average Percent Porosity - - - - - 19.7

Average Percent Oil Saturation - - - - - 39.7

Average Percent Water Saturation - - - - - 44.1

Average Oil Content, Bbls./A. Ft. - - - - - 608.

Total Oil Content, Bbls./Acre - - - - - 10,529.

Average Percent Oil Recovery by Laboratory Flooding Tests - - - - - 10.7

Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. - - - - - 162.

Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre - - - - - 2,267.

Total Calculated Oil Recovery, Bbls./Acre - - - - - 2,100.

Packer Setting, Feet - - - - -

Viscosity, Centipoises @ - - - - -

A. P. I. Gravity, degrees @ 60 °F - - - - -

Elevation, Feet - - - - -

The sand was cored in fresh water.

This core was sampled and the samples were sealed in cans by a representative of our laboratory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
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683.0 - 686.0	- Light brown micaceous slightly shaley sandstone.
686.0 - 687.8	- Brown slightly laminated micaceous slightly shaley sandstone.
687.8 - 688.1	- Shale.
688.1 - 696.3	- Brown slightly laminated micaceous slightly shaley sandstone.
696.3 - 700.6	- Brown to dark carbonaceous micaceous slightly shaley sandstone.
700.6 - 701.2	- Sandy shale.
701.2 - 702.2	- Dark gray shale.

Coring was started at a depth of 683.0 feet in light brown micaceous slightly shaley sandstone and completed at 702.2 feet in dark gray shale. This core shows a total of 17.3 feet of sandstone. For the most part, the pay is made up of brown slightly laminated micaceous 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 20.7, 36.1 and 9.7 millidarcys respectively; the overall average being 26.3 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile. The permeability of the sand varies from 1.4 to a maximum of 84 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 39.7. The weighted average percent oil saturation of the upper, middle and lower sections is 38.5, 38.3 and 44.0 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 45.8, 43.4 and 43.0 respectively; the overall average being 44.1 (See Table III). This gives an overall weighted average total fluid saturation of 83.8 percent.

The weighted average oil content of the upper, middle and lower sections is 542, 594 and 711 barrels per acre foot respectively; the overall average being 608. The total oil content, as shown by this core, is 10,529 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 2,267 barrels of oil per acre was obtained from 14.0 feet of sand. The weighted average percent oil saturation was reduced from 39.0 to 28.3, or represents an average recovery of 10.7 percent. The weighted average effective permeability of the samples is 2.19 millidarcys, while the average initial fluid production pressure is 23.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 17 samples tested, 14 produced water and oil. This indicates that approximately 82 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a rather wide variation in effective permeability.

CONCLUSION

From a study of the enclosed data, it is evident that an efficient

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water-flood within the vicinity of this well will recover approximately 2,100 barrels of oil per acre, or an average of 175 barrels of oil per acre foot from the 12.0 feet of good floodable pay sand analyzed. The following factors and assumptions were used in calculating this recovery:

Original formation volume factor	1.06
Present formation volume factor	1.02
True water saturation, percent	38.0
Primary oil recovery, percent	7.0
Calculated present oil saturation, percent	52.6
Porosity, percent	19.5
Oil saturation at abandonment, percent	29.0
Performance factor	0.50

The analysis results show 12.0 feet of good floodable pay sand in the interval extending from the top of the core to a depth of 696.3 feet. The sand in this interval has good oil and normal water saturations.

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RESULTS OF PERMEABILITY TESTS
TABLE I

Company K & M Oil Company Lease Hibbs "West" Well No. 3-B

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	683.2	11.	0.5	0.5	5.50
2	683.7	5.9	0.5	1.0	2.95
3	684.2	10.	0.5	1.5	5.00
4	684.7	5.1	0.5	2.0	2.55
5	685.2	18.	0.5	2.5	9.00
6	685.7	4.0	0.5	3.0	2.00
7	686.2	35.	0.5	3.5	17.50
8	686.7	62.	0.5	4.0	31.00
9	687.2	44.	0.5	4.5	22.00
10	687.7	5.9	0.3	4.8	1.77
11	688.2	30.	0.4	5.2	12.00
12	688.7	20.	0.5	5.7	10.00
13	689.2	45.	0.5	6.2	22.50
14	689.7	8.2	0.5	6.7	4.10
15	690.2	18.	0.5	7.2	9.00
16	690.7	51.	0.5	7.7	25.50
17	691.2	35.	0.5	8.2	17.50
18	691.7	34.	0.5	8.7	17.00
19	692.2	55.	0.5	9.2	27.50
20	692.7	30.	0.5	9.7	15.00
21	693.2	47.	0.5	10.2	23.50
22	693.7	23.	0.5	10.7	11.50
23	694.2	8.1	0.5	11.2	4.05
24	694.7	25.	0.5	11.7	12.50
25	695.2	74.	0.5	12.2	37.00
26	695.7	45.	0.5	12.7	22.50
27	696.2	84.	0.3	13.0	25.20
28	696.7	6.3	0.7	13.7	4.41
29	697.2	2.1	0.5	14.2	1.05
30	697.7	Imp.	0.5	14.7	0.00
31	698.2	31.	0.5	15.2	15.50
32	698.7	15.	0.5	15.7	7.50
33	699.2	1.4	0.5	16.2	0.70
34	699.7	3.9	0.5	16.7	1.95

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RESULTS OF SATURATION TESTS

TABLE II

Company K & M Oil Company Lease Hibbs "West" Well No. 3-B

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1	683.5	17.7	36	44	80	495	1.0	1.0	495
2	684.5	17.8	45	40	85	622	1.0	2.0	622
3	685.5	17.2	38	49	87	507	1.0	3.0	507
4	686.5	20.1	37	51	88	577	1.0	4.0	577
5	687.5	17.9	36	45	81	500	0.8	4.8	400
6	688.5	20.6	41	39	80	655	0.9	5.7	590
7	689.5	19.9	39	43	82	602	1.0	6.7	602
8	690.5	16.4	35	48	83	445	1.0	7.7	445
9	691.5	19.6	37	42	79	562	1.0	8.7	562
10	692.5	20.6	38	42	80	607	1.0	9.7	607
11	693.5	21.7	38	45	83	640	1.0	10.7	640
12	694.5	19.0	38	43	81	560	1.0	11.7	560
13	695.5	21.4	40	47	87	664	1.3	13.0	863
14	696.5	21.3	44	42	86	727	0.7	13.7	509
15	697.5	21.6	48	37	85	804	1.0	14.7	804
16	698.5	21.0	45	42	87	732	1.0	15.7	732
17	699.5	19.9	41	48	89	634	1.6	17.3	1,014
							Total-	- - - - -	10,529

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company K & M Oil Company Lease Hibbs "West" Well No. 3-B

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
683.0 - 687.8	4.8	20.7	99.27
688.1 - 696.3	8.2	36.1	296.35
696.3 - 700.0	3.2	9.7	31.11
683.0 - 700.0	16.2	26.3	426.73

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
683.0 - 687.8	4.8	18.1	38.5	45.8	542	2,601
688.1 - 696.3	8.2	19.9	38.3	43.4	594	4,869
696.3 - 700.6	4.3	20.8	44.0	43.0	711	3,059
683.0 - 700.6	17.3	19.7	39.7	44.1	608	10,529

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company K & M Oil Company Lease Hibbs "West" Well No. 3-B

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	683.5	17.8	36	498	13	180	23	73	318	55	1.62	20
2	684.5	17.4	45	607	15	202	30	68	405	93	2.30	25
3	685.5	17.4	38	514	13	176	25	66	338	30	0.900	25
4	686.5	19.7	37	566	7	107	30	64	459	49	1.21	25
5	687.5	17.9	36	501	4	56	32	65	445	14	0.510	30
6	688.5	20.5	41	652	16	254	25	65	398	33	0.767	20
7	689.5	20.2	39	612	12	188	27	67	424	44	1.17	20
8	690.5	17.0	35	462	7	92	28	69	370	3	0.068	40
9	691.5	19.4	37	557	9	135	28	61	422	23	0.556	20
10	692.5	20.2	38	595	11	172	27	68	423	94	3.45	15
11	693.5	21.6	38	637	12	201	26	72	436	170	9.70	15
12	694.5	19.5	38	575	11	166	27	71	409	99	2.69	15
13	695.5	21.2	40	658	16	263	24	70	395	112	4.12	15
14	696.5	21.1	47	770	0	0	47	45	770	0	Imp.	50+
15	697.5	21.5	48	800	2	33	46	45	767	18	0.606	40
16	698.5	20.9	47	762	0	0	47	39	762	0	Imp.	50+
17	699.5	20.0	41	637	0	0	41	46	637	0	Imp.	50+

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	K & M Oil Company		Lease	Hibbs "West"	Well No.	3-B
Depth Interval, Feet	683.0 - 687.8		688.1 - 698.0		683.0 - 698.0	
Feet of Core Analyzed	4.8		9.2		14.0	
Average Percent Porosity	18.0		20.0		19.3	
Average Percent Original Oil Saturation	38.5		39.3		39.0	
Average Percent Oil Recovery	10.7		10.8		10.7	
Average Percent Residual Oil Saturation	27.8		28.5		28.3	
Average Percent Residual Water Saturation	67.3		65.5		66.1	
Average Percent Total Residual Fluid Saturation	95.1		94.0		94.4	
Average Original Oil Content, Bbls./A. Ft.	538.		618.		590.	
Average Oil Recovery, Bbls./A. Ft.	148.		169.		162.	
Average Residual Oil Content, Bbls./A. Ft.	390.		449.		428.	
Total Original Oil Content, Bbls./Acre	2,586		5,680		8,266	
Total Oil Recovery, Bbls./Acre	710.		1,557.		2,267.	
Total Residual Oil Content, Bbls./Acre	1,876.		4,123.		5,999.	
Average Effective Permeability, Millidarcys	1.34		2.64		2.19	
Average Initial Fluid Production Pressure, p.s.i.	25.0		22.2		23.2	

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