



OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

February 19, 1966

O. A. Sutton
407 Insurance Building
Wichita, Kansas

Dear Sir:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Mann Lease, Well No. 3, Elk County, Kansas, and submitted to our laboratory on February 15, 1966.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman
Benjamin R. Pearman

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GENERAL INFORMATION & SUMMARY

Company O. A. Sutton Lease Mann Well No. 3

Location 30' West of Center W $\frac{1}{2}$ of E $\frac{1}{4}$, SE $\frac{1}{4}$

Section 12 Twp. 31S Rge. 12E County Elk State Kansas

Name of Sand	Layton
Top of Core	637.0
Bottom of Core	662.0
Top of Sand (Tested)	637.6
Bottom of Sand (Analyzed)	662.0
Total Feet of Permeable Sand	16.4
Total Feet of Floodable Sand (Analyzed)	12.4

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 1	3.0	3.0
10 - 50	3.0	6.0
50 - 100	5.0	11.0
100 - 200	3.4	14.4
200 & above	2.0	16.4

Average Permeability Millidarcys	83.9
Average Percent Porosity	19.2
Average Percent Oil Saturation	25.5
Average Percent Water Saturation	52.4
Average Oil Content, Bbls./A. Ft.	392.
Total Oil Content, Bbls./Acre	7,605.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.0
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	94.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,161.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	4,460.
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 cans by a representative of Oilfield Research Laboratories. The well was drilled in virgin territory. Several selected samples were subjected to flood-pot tests.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval,</u> <u>Feet</u>	<u>Description</u>
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637.0 - 640.0	- Gray and light brown, shaly, calcareous sandstone.
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640.0 - 644.0	- Shale.
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644.0 - 648.0	- Gray, laminated, shaly sandstone.
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648.0 - 652.6	- Brown and gray, laminated, slightly shaly sandstone.
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652.6 - 654.0	- Brown, slightly calcareous sandstone.
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654.0 - 654.6	- Brownish gray, calcareous sandstone.
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654.6 - 656.6	- Brown, slightly calcareous sandstone.
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656.6 - 658.6	- Brown and gray, laminated, slightly shaly sandstone.
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658.6 - 662.0	- Brown, slightly shaly sandstone.
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Coring was started at a depth of 637.0 feet in shaly, calcareous sandstone and completed at 662.0 feet in slightly shaly sandstone. For the most part, the pay is made up of brown, 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 0.37 and 98.3 millidarcys respectively; the overall average being 83.9 (See Table III). By observing the data given on the coregraph, it

is noticeable that the sand has an irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 203. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 25.5. The weighted average percent oil saturation of the upper and lower sections is 14.6 and 29.7 respectively. The weighted average percent water saturation of the upper and lower sections is 76.6 and 43.1 respectively; the overall average being 52.4 (See Table III). This gives an overall weighted average total fluid saturation of 77.9 percent. This low total fluid saturation indicates considerable fluid was lost during coring most of which was probably oil.

The weighted average oil content of the upper and lower sections is 150 and 485 barrels per acre foot respectively; the overall average being 392. The total oil content, as shown by this core, is 7,605 barrels per acre of which 6,612 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The sand tested in this core responded to laboratory flooding tests, as a total recovery of 1,161 barrels of oil per acre was obtained from 12.4 feet of sand. The weighted average percent oil saturation was reduced from 31.7 to 25.7, or represents an average recovery of 6.0 percent. The weighted average effective permeability of the samples is 1.76 millidarcys, while the average initial fluid production pressure is 25.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the

12 samples tested, all produced water and oil. This indicates that approximately 100 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

The results of the laboratory tests indicate that efficient primary and secondary operations in the vicinity of this well should recover approximately 4,460 barrels of oil per acre or an average of 360 barrels per acre foot from the 12.4 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.06
Reservoir water saturation, percent	30.0
Average porosity, percent	22.2
Oil saturation after flooding, percent	25.7
Performance factor, percent	50.0
Net floodable pay sand, feet	12.4

This core shows a pay sand section having a good oil saturation, a moderate water saturation and a wide variation in effective permeability to water.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company O. A. Sutton Lease Mann Well No. 3

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbbls. / A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
1	638.1	15.1	22	69	91	258	0.37	1.0	1.0	258	0.37
2	639.1	10.2	35	50	85	277	Imp.	1.0	2.0	277	0.00
3	645.1	15.4	6	87	93	72	Imp.	1.0	3.0	72	0.00
4	646.1	11.0	2	89	91	17	Imp.	1.0	4.0	17	0.00
5	647.1	17.2	10	85	95	133	0.37	1.4	5.4	186	0.52
6	648.1	22.4	28	42	70	487	51.	0.6	6.0	292	30.60
7	649.1	23.6	21	44	65	385	20.	1.0	7.0	385	20.00
8	650.1	16.9	6	84	90	79	13.	1.0	8.0	79	13.00
9	651.1	24.3	24	39	63	453	137.	1.0	9.0	453	137.00
10	652.1	22.7	33	37	70	582	184.	1.0	10.0	582	184.00
11	653.1	16.0	40	39	79	497	76.	1.4	11.4	696	106.40
12	654.1	7.2	29	42	71	162	0.98	0.6	12.0	97	0.59
13	655.1	22.7	28	41	69	494	84.	1.0	13.0	494	84.00
14	656.1	15.9	42	42	84	493	49.	1.0	14.0	493	49.00
15	657.1	25.2	35	39	74	646	203.	1.0	15.0	646	203.00
16	658.1	23.8	32	38	70	591	61.	1.0	16.0	591	61.00
17	659.1	25.4	30	42	72	589	203.	1.0	17.0	589	203.00
18	660.1	21.8	30	44	74	508	56.	1.0	18.0	508	56.00
19	661.1	25.6	32	35	67	636	163.	1.4	19.4	890	228.20
Total									7,605		

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Lease	Mann	Well No.
O. A. Sutton			3
	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys
	637.6 - 648.0	2.4	0.37
	648.0 - 662.0	14.0	98.3
	637.6 - 662.0	16.4	83.9
			Permeability Capacity Ft. x Md.
			0.89
			1,375.79
			1,376.68
	Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity
	637.6 - 648.0	5.4	14.0
	648.0 - 662.0	14.0	21.4
	637.6 - 662.0	19.4	19.2
			Average Percent Oil Saturation
			14.6
			29.7
			25.5
			Average Percent Water Saturation
			76.6
			43.1
			52.4
			Average Oil Content Bbl./A. Ft.
			150
			485
			392
			Total Oil Content Bbls./Acre
			810
			6,795
			7,605

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

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.			
6	648.1	22.4	28	486	2	35	26	52	451	15	0.300	40
7	649.1	23.2	21	378	2	36	19	62	342	24	0.500	30
9	651.1	24.0	24	446	3	56	21	63	390	98	1.70	20
10	652.1	22.2	33	568	8	138	25	56	430	43	0.700	30
11	653.1	15.8	40	490	12	147	28	55	343	30	0.600	30
13	655.1	22.4	28	486	3	52	25	66	434	67	1.20	20
14	656.1	15.6	42	508	16	193	26	60	315	32	0.600	30
15	657.1	24.8	35	673	7	135	28	58	538	192	3.10	20
16	658.1	23.4	32	581	3	54	29	55	527	59	1.00	20
17	659.1	25.9	30	601	4	80	26	61	521	192	4.40	20
18	660.1	22.0	30	511	3	51	27	64	460	42	0.900	30
19	661.1	25.4	32	630	5	99	27	62	531	219	4.80	20

Company O. A. Sutton Lease Mann Well No. 3

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	O. A. Sutton	Lease	Mann	Well No.	3
Depth Interval, Feet	648.0 - 662.0				
Feet of Core Analyzed	12.4				
Average Percent Porosity	22.2				
Average Percent Original Oil Saturation	31.7				
Average Percent Oil Recovery	6.0				
Average Percent Residual Oil Saturation	25.7				
Average Percent Residual Water Saturation	59.6				
Average Percent Total Residual Fluid Saturation	85.3				
Average Original Oil Content, Bbls./A. Ft.	534.				
Average Oil Recovery, Bbls./A. Ft.	94.				
Average Residual Oil Content, Bbls./A. Ft.	440.				
Total Original Oil Content, Bbls./Acre	6,612.				
Total Oil Recovery, Bbls./Acre	1,161.				
Total Residual Oil Content, Bbls./Acre	5,451.				
Average Effective Permeability, Millidarcys	1.76				
Average Initial Fluid Production Pressure, p.s.i.	25.8				

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