



OILFIELD RESEARCH LABORATORIES

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

June 24, 1967

Sanders-Thoureen, Inc.
P.O. Box 260
Lake Worth, Florida

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Inge Lease, Well No. CT-1, Elk County, Kansas, and submitted to our laboratory on June 17, 1967.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman
Benjamin R. Pearman

BRP:rf

4 c. - Lake Worth, Florida
1 c. - Bartlesville, Oklahoma

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company	Sanders-Thoureen, Inc.	Lease	Inge	Well No.	CT-1
Location	75' EWL & 50' SNL				
Section	34	Twp.	31S	Rge.	12E
		County	Elk		State
					Kansas
Name of Sand	-				Stray
Top of Core	-				657.0
Bottom of Core	-				708.5
Top of Sand	- (Analyzed)				657.5
Bottom of Sand	- (Analyzed)				698.5
Total Feet of Permeable Sand	-				21.9
Total Feet of Floodable Sand	-				10.8
 Distribution of Permeable Sand:					
Permeability Range Millidarcys	Feet		Cum. Ft.		
0 - 5	4.1		4.1		
5 - 10	3.1		7.2		
10 - 20	4.4		11.6		
20 - 50	5.3		16.9		
50 - 100	4.0		20.9		
100 & above	1.0		21.9		
Average Permeability Millidarcys	-				34.4
Average Percent Porosity	-				19.1
Average Percent Oil Saturation	-				26.9
Average Percent Water Saturation	-				57.9
Average Oil Content, Bbls./A. Ft.	-				395.
Total Oil Content, Bbls./Acre	-				9,158.
Average Percent Oil Recovery by Laboratory Flooding Tests	-				7.6
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	-				124.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	-				1,338.
Total Calculated Oil Recovery, Bbls./Acre	-				2,960.
Packer Setting, Feet	-				
Viscosity, Centipoises @	-				
A. P. I. Gravity, degrees @ 60 °F	-				
Elevation, Feet	-				

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

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, <u>Feet</u>	<u>Description</u>
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657.0 - 659.5	- Grayish light brown, slightly calcareous sandstone.
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659.5 - 660.2	- Gray sandy limestone.
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660.2 - 661.3	- Hard, brown, shaly, carbonaceous, calcareous sandstone.
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661.3 - 661.8	- Gray shale.
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661.8 - 662.2	- Brown, slightly carbonaceous, calcareous sandstone.
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662.2 - 665.2	- Gray shale.
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665.2 - 665.3	- Coal.
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665.3 - 665.8	- Gray shale.
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665.8 - 668.5	- Gray and light brown, laminated, sandy shale.
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668.5 - 669.1	- Gray shale.
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669.1 - 669.2	- Coal.
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669.2 - 669.5	- Light brown, sandy shale.
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669.5 - 672.9	- Brown, slightly calcareous sandstone.
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672.9 - 674.2	- Gray, laminated, shaly sandstone.
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674.2 - 678.8	- Brown, slightly calcareous sandstone with a vertical fracture from 678.5 to 678.8.
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678.8 - 679.8	- Gray sandy limestone with a vertical fracture from 678.8 to 679.5.
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679.8 - 681.8	- Gray sandy limestone.
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681.8 - 686.5 - Brown calcareous sandstone.
686.5 - 689.5 - Gray shale.
689.5 - 689.9 - Coal.
689.9 - 692.0 - Gray sandy shale with a vertical fracture from 690.5 to 692.0.
692.0 - 694.0 - Gray shaly sandstone with a vertical fracture from 692.0 to 692.1.
694.0 - 694.2 - Coal.
694.2 - 708.5 - Gray shaly sandstone.

Coring was started at a depth of 657.0 feet in sandstone and completed at 708.5 feet in gray, laminated, shaly sandstone. For the most part, the pay is made up of brown, more or less, calcareous 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 11.1, 45.6 and 12.4 millidarcys respectively; the overall average being 34.4 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather irregular permeability profile. The permeability of the sand varies from impermeable to a maximum of 161. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 26.9. The weighted average percent oil saturation of the upper, middle and lower sections is 29.4, 28.9 and 8.3 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 51.2, 54.1 and 86.6 respect-

ively; the overall average being 57.9 (See Table III). This gives an overall weighted average total fluid saturation of 84.8 percent.

The weighted average oil content of the upper, middle and lower sections is 320, 461 and 140 barrels per acre foot respectively; the overall average being 395. The total oil content, as shown by this core, is 9,158 barrels per acre of which 5,991 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 1,338 barrels of oil per acre was obtained from 10.8 feet of sand. The weighted average percent oil saturation was reduced from 34.0 to 26.4, or represents an average recovery of 7.6 percent. The weighted average effective permeability of the samples is 1.33 millidarcys, while the average initial fluid production pressure is 26.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 24 samples tested, 22 produced water and 10 oil. This indicates that approximately 42 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

Based on the results of the laboratory tests, it appears that efficient water-flooding operations in the vicinity of this well should recover approximately 2,960 barrels of oil per acre or an average of 219 barrels per acre foot from 13.5 feet of floodable pay

sand. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.05
Present formation volume factor	1.01
Reservoir water saturation, percent	38.0
Primary recovery, estimated, percent	6.0
Present oil saturation, percent	53.6
Average porosity, percent	21.0
Oil saturation after flooding, percent	26.4
Performance factor, percent	50.0
Net floodable pay sand, feet	13.5

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.

The above recovery values were calculated assuming that the property will be efficiently developed and operated throughout its flood life.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

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	658.0	14.3	21	59	80	233	11.	1.0	1.0	233	11.00
2	659.0	18.4	23	61	84	328	26.	1.0	2.0	328	26.00
3	660.0	7.4	26	56	82	149	6.7	0.7	2.7	105	4.69
4	661.0	14.8	37	40	77	425	1.6	1.1	3.8	468	1.76
5	662.0	13.1	52	29	83	528	8.0	0.4	4.2	211	3.20
6	670.0	22.3	21	54	75	363	14.	1.0	5.2	363	14.00
7	671.0	22.8	23	50	73	406	19.	1.0	6.2	406	19.00
8	672.0	23.7	29	51	80	533	16.	1.4	7.6	745	22.40
9	673.0	15.3	15	82	97	178	0.36	0.6	8.2	107	0.22
10	674.0	22.8	27	54	81	478	2.1	0.7	8.9	335	1.47
11	675.0	22.4	41	54	95	712	44.	1.3	10.2	925	57.20
12	676.0	23.9	32	44	76	592	35.	1.0	11.2	592	35.00
13	677.0	20.0	41	45	86	636	86.	1.0	12.2	636	86.00
14	678.0	22.3	34	48	82	588	88.	1.3	13.5	764	114.40
15	679.0	21.5	41	44	85	683	5.3	1.0	14.5	683	5.30
16	680.0	8.3	34	62	96	218	0.71	0.7	15.2	153	0.50
17	681.0	5.6	30	65	95	130	Imp.	1.3	16.5	169	0.00
18	682.0	21.5	32	44	76	534	73.	0.7	17.2	374	51.10
19	683.0	19.9	30	50	80	463	49.	1.0	18.2	463	49.00
20	684.0	24.2	20	64	84	375	161.	1.0	19.2	375	161.00
21	685.0	23.0	17	65	82	303	54.	1.0	20.2	303	54.00
22	691.0	23.0	14	81	95	250	5.5	1.0	21.2	250	5.50
23	693.0	17.6	3	95	98	41	2.8	1.0	22.2	41	2.80
24	698.0	20.8	8	84	92	129	29.	1.0	23.2	129	29.00
								Total	-----	9,158	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Sanders-Thoureen, Inc.			Lease	Inge	Well No.	CT-1
	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.			
	657.5 - 662.2	4.2	11.1	46.65			
	669.5 - 685.5	14.7	45.6	670.59			
	690.5 - 698.5	3.0	12.4	37.30			
	657.5 - 698.5	21.9	34.4	754.54			
	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
	657.5 - 662.2	4.2	14.1	29.4	51.2	320	1,345
	669.5 - 685.5	16.0	20.2	29.8	54.1	461	7,393
	690.5 - 698.5	3.0	20.4	8.3	86.6	140	420
	657.5 - 698.5	23.2	19.1	26.9	57.9	395	9,158

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Sanders-Thoureen, Inc.			Lease		Inge		Well No.		CT-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	658.0	14.5	22	247	0	0	22	70	247	8	0.200	45
2	659.0	18.6	23	332	2	29	21	75	303	17	0.400	40
3	660.0	7.7	25	149	0	0	25	68	149	5	0.100	50
4	661.0	15.0	37	430	8	93	29	60	337	5	0.100	50
5	662.0	13.6	52	549	0	0	52	42	549	7	0.200	45
6	670.0	22.7	22	387	0	0	22	62	387	14	0.400	40
7	671.0	22.6	23	404	0	0	23	68	404	11	0.300	40
8	672.0	23.2	29	521	8	144	21	65	377	19	0.400	30
9	673.0	15.8	16	196	0	0	16	82	196	12	0.300	40
10	674.0	22.3	27	466	0	0	27	68	466	7	0.200	40
11	675.0	22.7	41	722	10	176	31	65	546	22	0.600	30
12	676.0	24.3	32	603	4	75	28	65	528	30	0.600	30
13	677.0	20.2	41	642	11	172	30	69	470	78	1.60	10
14	678.0	22.8	34	601	8	141	26	72	460	58	1.30	10
15	679.0	21.0	41	668	7	114	34	65	554	15	0.376	30
16	680.0	8.0	34	211	0	0	34	63	211	0	Imp.	-
17	681.0	5.7	31	137	0	0	31	67	137	0	Imp.	-
18	682.0	21.2	32	526	7	115	25	74	411	301	7.20	10
19	683.0	19.5	30	454	10	151	20	72	303	108	3.20	20
20	684.0	24.1	20	374	0	0	20	76	374	475	23.40	10
21	685.0	23.0	18	321	0	0	18	80	321	483	13.00	10
22	691.0	22.7	14	246	0	0	14	85	246	35	0.933	20
23	693.0	18.0	5	70	0	0	5	94	70	64	1.30	20
24	698.0	21.1	9	147	0	0	9	90	147	155	3.30	10

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	Sanders-Thoureen, Inc.	Lease	Inge	Well No.	CT-1
Depth Interval, Feet	657.5 - 662.2	669.5 - 685.5	657.5 - 685.5		
Feet of Core Analyzed	2.1	8.7	10.8		
Average Percent Porosity	16.7	22.0	21.0		
Average Percent Original Oil Saturation	30.3	35.0	34.0		
Average Percent Oil Recovery	5.1	8.2	7.6		
Average Percent Residual Oil Saturation	25.2	26.8	26.4		
Average Percent Residual Water Saturation	67.1	68.1	67.9		
Average Percent Total Residual Fluid Saturation	92.3	94.9	94.3		
Average Original Oil Content, Bbls./A. Ft.	382.	596.	555.		
Average Oil Recovery, Bbls./A. Ft.	62.	139.	124.		
Average Residual Oil Content, Bbls./A. Ft.	320.	457.	431.		
Total Original Oil Content, Bbls./Acre	805.	5,186.	5,991.		
Total Oil Recovery, Bbls./Acre	131.	1,207.	1,338.		
Total Residual Oil Content, Bbls./Acre	674.	3,979.	4,653.		
Average Effective Permeability, Millidarcys	0.243	1.59	1.33		
Average Initial Fluid Production Pressure, p.s.i.	45.0	21.2	26.0		

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