

# OILFIELD RESEARCH LABORATORIES

- REGISTERED ENGINEERS -

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February 25, 1961

Paw-Cat Associates  
1736 South Minnesota  
Wichita 10, Kansas

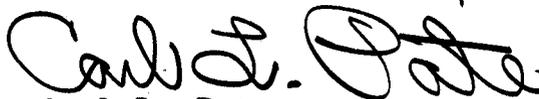
Gentlemen:

Enclosed herewith is the report of the analysis of the Cable Tool core taken from the Frank Brady Lease, Well No. 1, Franklin County, Kansas, and submitted to our laboratory on February 20, 1961.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES



Carl L. Pate

CLP:db

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# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

Company Paw-Cat Associates Lease Frank Brady Well No. 1

Location 350' S of N Line and 150' E of W Line of NW $\frac{1}{4}$

Section 29 Twp. 15S Rge. 20E County Franklin State Kansas

Name of Sand	Squirrel
Top of Core	758.3
Bottom of Core	787.6
Top of Sand	758.3
Bottom of Sand	783.2
Total Feet of Permeable Sand	15.3
Total Feet of Floodable Sand	10.2

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 20	2.0	2.0
20 - 50	8.7	10.7
50 - 100	4.1	14.8
100 & above	0.5	15.3

Average Permeability Millidarcys	41.6
Average Percent Porosity	21.0
Average Percent Oil Saturation	33.0
Average Percent Water Saturation	53.6
Average Oil Content, Bbls./A. Ft.	540.
Total Oil Content, Bbls./Acre	13,431.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.4
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	106.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,080.
Total Calculated Oil Recovery, Bbls./Acre	1,650.
Packer Setting, Feet	-
Viscosity, Centipoises @ <u>79°F.</u>	69.4
A. P. I. Gravity, degrees @ 60 °F	26.8
Elevation, Feet	-

This well was cored with a cable tool core barrel using fresh water as the coring fluid. The well was drilled in non-virgin territory. The core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories.

#### FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval,</u>	<u>Description</u>
<u>Feet</u>	

758.3 - 761.3	- Grayish brown fine grained laminated sandstone.
761.3 - 765.1	- Grayish light brown fine grained laminated sandstone.
765.1 - 769.0	- Brown fine grained laminated sandstone.
769.0 - 770.1	- Grayish light brown slightly shaley sandstone.
770.1 - 774.1	- Light brown fine grained laminated sandstone.
774.1 - 774.7	- Grayish light brown fine grained laminated shaley sandstone.
774.7 - 779.1	- Grayish light brown fine grained finely laminated sandstone.
779.1 - 783.2	- Grayish light brown fine grained sandstone.
783.2 - 785.0	- Gray shaley sandstone.
785.0 - 787.6	- Shale discarded at well.

Coring was started at a depth of 758.3 feet in laminated sandstone and completed at 787.6 feet in shale. This core shows a total of 24.9 feet of sandstone. For the most part, the pay is made up of grayish light brown fine grained laminated 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 43.8 and 37.1 millidarcys respectively; the overall average being 41.6 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a fairly uniform permeability profile. The permeability of the sand varies from Imp. to a maximum of 111 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fair weighted average percent oil saturation, namely, 33.0. The weighted average percent oil saturation of the upper and lower sections is 33.0 and 32.9 respectively. The weighted average percent water saturation of the upper and lower sections is 51.5 and 57.4 respectively; the overall average being 53.6 (See Table III). This gives an overall weighted average total fluid saturation of 86.6 percent.

The weighted average oil content of the upper and lower sections is 536 and 544 barrels per acre foot respectively; the overall average being 540. The total oil content, as shown by this core, is 13,431 barrels per acre (See Table III).

VISCOSITY

The viscosity of a sample of crude oil taken from the well is 69.4 centipoises at 79 degrees F. The A.P.I. gravity of the oil is 26.8 degrees at 60 degrees F. With other factors being favorable, a sand containing an oil of this viscosity should respond to water-flooding.

LABORATORY FLOODING TESTS

Due to the soft nature of the sand in this core, it was possible to get only 14 samples for laboratory flooding tests. This portion of the core responded rather well to laboratory flooding tests, as a total recovery of 1,080 barrels of oil per acre was obtained from 10.2 feet of sand. The weighted average percent oil saturation was reduced from 39.2 to 32.8, or represents an average recovery of 6.4 percent. The weighted average effective permeability of the samples is 1.73 millidarcys, while the average initial fluid production pressure is 35 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 14 samples tested, 13 produced water and 10 oil. This indicates that approximately 72 percent of the sand represented by these samples is floodable pay

sand. The tests also show that the sand has a fairly wide variation in effective permeability to water.

### CONCLUSION

Based on the results of the laboratory tests, it appears that approximately 1,650 barrels of oil per acre could be recovered from the area in the vicinity of this well by efficient water-flooding methods. This represents an average recovery of 162 barrels of oil per acre foot from the 10.2 feet of floodable pay sand analyzed in this core. This calculated recovery is a minimum value, as it was impossible to obtain sufficient samples to test the entire core, because of the soft nature of the sand.

The above recovery value was calculated using the following data and assumptions:

Original formation volume factor	1.05
Present formation volume factor	1.02
Average reservoir water saturation, percent	40.0
Primary production, estimated, percent	7.0
Present oil saturation, percent	51.3
Average porosity, percent	21.0
Abandonment oil saturation, percent	32.8
Performance factor, percent	55.0
Net floodable pay sand, feet	10.2

This core shows a clean sand section having a fair oil saturation, a somewhat high water saturation and a rather wide variation in effective permeability to water.

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**RESULTS OF PERMEABILITY TESTS**

**TABLE I**

Company Paw-Cat Associates Lease Frank Brady Well No. 1

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	759.3	111.	0.5	0.5	55.50
2	759.8	39.	0.5	1.0	19.50
3	760.9	47.	0.8	1.8	36.60
4	763.3	42.	0.5	2.3	21.00
5	763.8	37.	0.5	2.8	18.50
6	764.8	37.	0.6	3.4	22.20
7	765.3	25.	0.4	3.8	10.00
8	765.8	54.	0.5	4.3	27.00
9	766.8	51.	0.5	4.8	25.50
10	767.3	46.	0.5	5.3	23.00
11	767.8	55.	0.5	5.8	27.50
12	768.8	53.	0.5	6.3	26.50
13	770.3	61.	0.4	6.7	24.40
14	770.8	15.	0.5	7.2	7.50
15	771.3	17.	0.5	7.7	8.50
16	771.8	20.	0.5	8.2	10.00
17	772.3	21.	0.5	8.7	10.50
18	772.8	69.	0.5	9.2	34.50
19	773.3	38.	0.5	9.7	19.00
20	773.8	39.	0.6	10.3	23.40
21	774.3	Imp.	0.4	10.7	0.00
22	774.8	54.	0.3	11.0	16.20
23	778.8	44.	0.6	11.6	26.40
24	779.3	57.	0.4	12.0	22.80
25	779.8	38.	0.5	12.5	19.00
26	780.3	13.	0.5	13.0	6.50
27	780.8	26.	0.5	13.5	13.00
28	781.3	25.	0.5	14.0	12.50
29	781.8	61.	0.5	14.5	30.50
30	782.3	48.	0.5	15.0	24.00
31	782.8	21.	0.7	15.7	14.70

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## RESULTS OF SATURATION TESTS

TABLE II

Company Paw-Cat Associates Lease Frank Brady Well No. 1

Set. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation		Total	Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water			Ft.	Cum. Ft.	
1	758.4	18.0	19	76	95	265	0.7	0.7	185
2	759.5	22.3	38	46	84	658	1.0	1.7	658
3	760.5	24.6	33	43	76	629	1.3	3.0	816
4	761.5	20.2	25	57	82	391	0.7	3.7	274
5	762.5	18.8	27	53	80	394	1.0	4.7	394
6	763.5	22.8	36	42	78	637	1.0	5.7	637
7	764.5	19.4	34	52	86	511	1.1	6.8	562
8	765.5	20.3	32	52	84	504	0.9	7.7	454
9	766.5	21.0	32	50	82	521	1.0	8.7	521
10	767.5	22.6	29	54	83	509	1.0	9.7	509
11	768.5	20.4	35	49	84	554	1.0	10.7	554
12	769.5	19.4	25	61	86	376	1.1	11.8	414
13	770.5	20.2	47	41	88	735	0.9	12.7	661
14	771.5	21.1	32	52	84	523	1.0	13.7	523
15	772.5	20.7	35	53	88	563	1.0	14.7	563
16	773.5	20.4	43	52	95	680	1.1	15.8	748
17	774.5	19.4	25	68	93	376	0.6	16.4	226
18	775.5	21.1	22	68	90	360	1.3	17.7	468
19	776.5	22.0	31	54	85	528	1.0	18.7	528
20	777.5	23.4	25	66	91	454	1.0	19.7	454
21	778.5	19.9	33	61	94	510	1.1	20.8	561
22	779.5	20.9	40	53	93	648	0.9	21.7	584
23	780.5	21.4	27	59	86	448	1.0	22.7	448
24	781.5	21.1	42	47	89	688	1.0	23.7	688
25	782.5	22.0	49	43	92	835	1.2	24.9	1,001

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## SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Lease	Well No.					
Paw-Cat Associates	Frank Brady	1					
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content, Bbl./A. Ft.	Total Oil Content, Bbls./Acre
758.3 - 774.1	10.3	43.8	450.60	33.0	51.5	536	8,473
774.1 - 783.2	5.0	37.1	185.60	32.9	57.4	544	4,958
758.3 - 783.2	15.3	41.6	636.20	33.0	53.6	540	13,431

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RESULTS OF LABORATORY FLOoding TESTS

TABLE IV

Company Paw-Cat Associates Lease Frank Brady Well No. 1

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation		Volume of Water Recovered cc <sup>a</sup>	Effective Permeability Millidarcys	Initial Fluid Production Pounds/Day/Inch
			%	BBbl./A. Ft.	%	BBbl./A. Ft.	%	BBbl./A. Ft.			
2	759.5	22.2	38	654	6	103	32	55	13	0.402	40
6	763.5	22.6	35	614	0	0	35	51	33	1.17	30
7	764.5	19.9	34	524	0	0	34	55	86	2.04	20
8	765.5	20.1	33	514	0	0	33	53	6	0.149	50
9	766.5	21.4	32	531	2	33	30	57	15	0.787	40
11	768.5	20.7	35	561	3	48	32	54	18	0.576	30
13	770.5	20.7	47	754	17	273	30	64	20	0.823	30
14	771.5	20.8	32	516	2	32	30	60	4	0.108	50
15	772.5	20.3	37	582	0	0	37	54	0	Imp.	50+
16	773.5	20.8	43	693	10	161	33	54	54	7.20	30
21	778.5	20.2	33	516	4	63	29	64	86	2.77	20
22	779.5	21.1	40	654	3	49	37	69	8	0.448	50
24	781.5	21.3	42	694	6	99	36	55	19	0.581	30
25	782.5	22.4	49	851	11	191	38	55	67	2.59	30

Notes: cc—cubic centimeters.

a.—Volume of water recovered at the time of maximum oil recovery.

cc.—Determined by passing water through sample which still contains residual oil.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Paw-Cat Associates	Lease	Frank Brady	Well No.	1
Depth Interval, Feet	758.3 - 773.0	773.0 - 783.2	758.3 - 783.2		
Feet of Core Analyzed	4.9	5.3	10.2		
Average Percent Porosity	21.2	21.2	21.2		
Average Percent Original Oil Saturation	36.6	41.6	39.2		
Average Percent Oil Recovery	5.8	7.0	6.4		
Average Percent Residual Oil Saturation	30.8	34.6	32.8		
Average Percent Residual Water Saturation	57.8	59.0	58.5		
Average Percent Total Residual Fluid Saturation	88.6	93.6	91.3		
Average Original Oil Content, Bbbls./A. Ft.	599.	685.	645.		
Average Oil Recovery, Bbbls./A. Ft.	94.	117.	106.		
Average Residual Oil Content, Bbbls./A. Ft.	505.	568.	539.		
Total Original Oil Content, Bbbls./Acre	2,941.	3,631.	6,572.		
Total Oil Recovery, Bbbls./Acre	462.	618.	1,080.		
Total Residual Oil Content, Bbbls./Acre	2,479.	3,013.	5,492.		
Average Effective Permeability, Millidarcys	0.534	2.84	1.73		
Average Initial Fluid Production Pressure, p.s.i.	38.	32.	35.		

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