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

OILFIELD RESEARCH LABORATORIES

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April 30, 1962

Paw-Cat Associates
6611 Clayton Road
St. Louis 17, Missouri

Gentlemen:

Enclosed herewith is the report of the analysis of the Cable Tool core taken from the Frank Brady Lease, Franklin County, Kansas, and submitted to our laboratory on April 24, 1962.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABQRATORIES

Benjamin R. Pearman

Benjamin R. Pearman

BRP:rf

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GENERAL INFORMATION & SUMMARY

Company Paw-Cat Associates Lease F. Brady Well No. 1-W

Location NW¼

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

Name of Sand	Squirrel
Top of Core	745.0
Bottom of Core	770.9
Top of Sand	745.0
Bottom of Sand	767.0
Total Feet of Permeable Sand	18.6
Total Feet of Floodable Sand (Analyzed)	13.1

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 45	5.0	5.0
45 - 65	6.4	11.4
65 - 100	3.2	14.6
100 & above	4.0	18.6

Average Permeability Millidarcys	63.5
Average Percent Porosity	21.4
Average Percent Oil Saturation	31.8
Average Percent Water Saturation	54.8
Average Oil Content, Bbls./A. Ft.	533.
Total Oil Content, Bbls./Acre	10,348.
Average Percent Oil Recovery by Laboratory Flooding Tests	3.4
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	56.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	730.
Total Calculated Oil Recovery, Bbls./Acre	3,360.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water was used as the coring fluid in taking this core. The core was sampled and the samples sealed in cans by a representative of the laboratory. It was reported that the well was drilled in semi-virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
745.0 - 747.5	Gray and light brown, laminated, shaly sandstone.
747.5 - 755.4	Brown, fine grained sandstone.
755.4 - 758.0	Gray sandy shale.
758.0 - 767.0	Brown, fine grained sandstone.
767.0 - 770.9	Shale.

Coring was started at a depth of 745.0 feet in laminated shaly sandstone and completed at 770.9 feet in shale. This core shows a total of 19.4 feet of sandstone. For the most part, the pay is made up of brown, fine grained 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 42.0 and 86.4 millidarcys respectively; the overall average being 63.5 (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 6.6 to a maximum of 115. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 31.8. The weighted average percent oil saturation of the upper and lower sections is 28.9 and 35.2 respectively. The weighted average percent water saturation of the upper and lower sec-

tions is 57.1 and 52.0 respectively; the overall average being 54.8 (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 454 and 625 barrels per acre foot respectively; the overall average being 533. The total oil content, as shown by this core, is 10,348 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded rather well to laboratory flooding tests, as a total recovery of 730 barrels of oil per acre was obtained from 13.1 feet of sand. The weighted average percent oil saturation was reduced from 31.3 to 27.9, or represents an average recovery of 3.4 percent. The weighted average effective permeability of the samples is 4.10 millidarcys, while the average initial fluid production pressure is 26.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 15 samples tested, all produced water and 13 oil. This indicates that approximately 87 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand in general has a rather uniform permeability to water.

CONCLUSION

A study of the laboratory data indicates that an efficient waterflood in the vicinity of this well should recover approximately 3,360 barrels of oil per acre. This represents an average recovery of 199 barrels per acre foot from the 16.9 feet of floodable pay sand analyzed in this core.

The following data and assumptions were used in calculating the above recovery values:

Original formation volume factor	1.05
Present formation volume factor	1.02
Reservoir water saturation, percent	44.0
Primary recovery, estimated, percent	3.0
Present oil saturation, percent	51.5
Average porosity, percent	21.2
Oil saturation after flooding, percent	27.9
Performance factor, percent	55.0
Net floodable pay sand, feet	16.9

This core shows a rather clean pay sand section having a fairly good oil saturation, a moderate water saturation and good effective permeability to water.

Because of the soft nature of the sand it was impossible to obtain sufficient flood-pot samples to completely analyze this core. However, a study of the saturation data indicates that 3.8 feet of floodable pay sand are in the untested portion of the core. This 3.8 feet was included in the above recovery calculations.

The above recovery values were calculated assuming that satisfactory injection rates will be maintained throughout the flood life.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Paw-Cat Associates Lease F. Brady Well No. 1-W

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	745.1	19.4	26	54	80	391	48.	0.6	0.6	234	28.80
2	746.1	20.7	26	53	79	417	6.6	1.0	1.6	417	6.60
3	747.1	17.7	17	79	96	233	63.	0.9	2.5	210	56.70
4	748.1	17.9	32	59	91	444	47.	1.1	3.6	488	51.60
5	749.1	19.9	34	56	90	525	33.	1.0	4.6	525	33.00
6	750.1	20.4	32	54	86	506	47.	1.0	5.6	506	47.00
7	751.1	20.3	29	57	86	456	42.	1.0	6.6	456	42.00
8	752.1	20.0	30	57	87	465	39.	1.0	7.6	465	39.00
9	753.1	21.1	31	51	82	508	56.	1.0	8.6	508	56.00
10	754.1	22.4	28	52	80	485	43.	1.0	9.6	485	43.00
11	755.1	22.3	31	57	88	536	-	0.8	10.4	429	-
12	758.1	22.5	29	56	85	506	48.	0.8	11.2	405	38.40
13	759.5	22.5	32	59	91	559	92.	1.2	12.4	670	110.50
14	760.5	22.2	36	49	85	619	71.	1.0	13.4	619	71.00
15	761.5	20.4	31	56	87	490	49.	1.0	14.4	490	49.00
16	762.5	21.6	33	53	86	553	115.	1.0	15.4	553	115.00
17	763.5	23.2	42	44	86	755	65.	1.0	16.4	755	65.00
18	764.5	24.1	33	49	82	616	114.	1.0	17.4	616	114.00
19	765.5	23.4	35	52	82	635	100.	1.0	18.4	635	100.00
20	766.5	25.3	45	50	95	882	115.	1.0	19.4	882	115.00
								Total	-------	10,348	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Paw-Cat Associates Lease F. Brady Well No. 1-W

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
745.0 - 754.6	9.6	42.0	403.70
758.0 - 767.0	9.0	86.4	777.90
745.0 - 767.0	18.6	63.5	1,181.60

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
745.0 - 755.4	10.4	20.2	28.9	57.1	454	4,723
758.0 - 767.0	9.0	22.8	35.2	52.0	625	5,625
745.0 - 767.0	19.4	21.4	31.8	54.8	533	10,348

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Paw-Cat Associates Lease F. Brady Well No. 1-W

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc[a]	Effective Permeability Millidarcys[b]	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	745.1	19.0	24	354	0	0	24	63	354	4	0.088	40
2	746.1	20.1	25	390	0	0	25	64	390	10	0.105	45
4	748.1	18.2	32	451	3	42	29	66	409	32	1.16	40
5	749.1	19.5	34	515	5	76	29	64	439	32	0.796	40
6	750.1	20.7	32	514	5	80	27	67	434	115	3.69	30
7	751.1	20.8	29	468	3	48	26	66	420	154	4.64	30
8	752.1	20.4	30	475	2	32	28	62	443	88	2.76	30
9	753.1	20.7	31	498	3	48	28	64	450	40	1.02	30
10	754.1	22.0	28	478	2	34	26	70	444	240	5.55	20
12	758.1	22.8	29	513	4	71	25	71	442	191	6.12	20
13	759.5	22.1	32	549	5	86	27	65	463	199	5.53	20
14	760.5	22.1	36	599	3	51	32	60	548	165	6.76	20
15	761.5	20.9	31	502	1	16	30	64	486	34	0.726	20
16	762.5	22.0	33	563	6	102	27	66	461	204	5.29	20
19	765.5	23.8	30	554	2	37	28	62	517	327	8.52	20
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Notes: cc—cubic centimeter.

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

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Paw-Cat Associates Lease F. Brady Well No. 1-W

Depth Interval, Feet	747.5 - 754.6	758.0 - 766.0	747.5 - 766.0
Feet of Core Analyzed	7.1	6.0	13.1
Average Percent Porosity	20.3	22.3	21.2
Average Percent Original Oil Saturation	30.9	31.8	31.3
Average Percent Oil Recovery	3.3	3.5	3.4
Average Percent Residual Oil Saturation	27.6	28.3	27.9
Average Percent Residual Water Saturation	65.6	64.4	65.1
Average Percent Total Residual Fluid Saturation	93.2	92.7	93.0
Average Original Oil Content, Bbls./A. Ft.	485.	548.	515.
Average Oil Recovery, Bbls./A. Ft.	51.	61.	56.
Average Residual Oil Content, Bbls./A. Ft.	434.	487.	459.
Total Original Oil Content, Bbls./Acre	3,444.	3,287.	6,731.
Total Oil Recovery, Bbls./Acre	364.	366.	730.
Total Residual Oil Content, Bbls./Acre	3,080.	2,921.	6,001.
Average Effective Permeability, Millidarcys	2.78	5.48	4.10
Average Initial Fluid Production Pressure, p.s.i.	31.4	20.0	26.2

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