

OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

January 6, 1951

Kewanee Oil Company
Kennedy Building
P. O. Box 2839
Tulsa 1, Oklahoma

Gentlemen:

Enclosed herewith is the report of the analysis of the No. 6 Baker barrel core taken from the Bandy Lease, Well No. 20, Anderson County, Kansas, and submitted to our laboratory on December 12, 1950.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Fate

CLF:mn

c.c. to Mr. H. T. Harris
A. F. D.
Garnett, Kansas

Kewanee Oil Company
Chidler, Oklahoma

KIEWITZ OIL COMPANY

CORE ANALYSIS REPORT

BANDY LEASE WELL NO. 20

ANDERSON COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANDLER, KANSAS

JANUARY 6, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Kewanee Oil Company Lease Bandy Well No. 20

Location SE₄ of the SE₄

Section 32 Twp. 20S Rge. 21E County Anderson State Kansas

Name of Sand	Squirrel
Top of Core	600.50
Bottom of Core	636.55
Top of Sand	605.50
Bottom of Sand	630.35
Total Feet of Permeable Sand	9.40

Distribution of Permeable Sand:
Permeability Range
Millidarcys

Feet

Cum. Ft.

0 - 10	1.20	1.20
10 - 15	1.55	2.75
15 - 20	1.05	3.80
20 - 30	3.25	7.05
30 - 40	1.70	8.75
40 & above	0.65	9.40

Average Permeability Millidarcys	22.08
Average Percent Porosity	18.52
Average Percent Oil Saturation	30.60
Average Percent Water Saturation	59.65
Average Oil Content, Bbls./A. Ft.	453.
Total Oil Content, Bbls./Acre	5,644.
Average Percent Oil Recovery by Laboratory Flooding Tests	9.69
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	159.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,335.
Total Calculated Oil Recovery, Bbls./Acre	1,750.
Packer Setting, Feet	606.00
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	

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The above averages are for that part of the cored section extending from the packer setting to the top of the cement plug.

Water was used as a circulating fluid in the coring of the sand in this well.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval,</u> <u>Feet</u>	<u>Description</u>
600.50 - 600.90	- Gray shale.
600.90 - 601.20	- Light brown fine grained sandstone.
601.20 - 601.70	- Gray shale.
601.70 - 602.00	- Laminated shaley sandstone.
602.00 - 603.50	- Gray shale.
603.50 - 603.70	- Light brown fine grained laminated micaceous shaley sandstone.
603.70 - 604.25	- Gray sandy shale.
604.25 - 604.55	- Gray shale.
604.55 - 605.30	- Light brown fine grained micaceous shaley sandstone containing a shale break.
605.30 - 605.50	- Laminated sandy shale.
605.50 - 606.20	- Brown fine grained micaceous sandstone.
606.20 - 606.50	- Gray shale.
606.50 - 607.40	- Light brown fine grained micaceous shaley sandstone.
607.40 - 607.90	- Finely laminated sandy shale.
607.90 - 608.40	- Brown fine grained micaceous sandstone.
608.40 - 610.25	- Gray sandy shale.
610.25 - 610.45	- Light brown fine grained finely laminated micaceous shaley sandstone.

610.45 - 610.60 - Brown fine grained micaceous sandstone.
610.60 - 610.85 - Finely laminated sandy shale.
610.85 - 611.10 - Brown fine grained micaceous sandstone.
611.10 - 612.50 - Laminated sandy shale.
612.50 - 614.05 - Brown fine grained micaceous sandstone.
614.05 - 614.35 - Brown fine grained micaceous slightly shaley sandstone.
614.35 - 616.10 - Gray sandy shale.
616.10 - 616.60 - Laminated shaley sandstone.
616.60 - 617.30 - Finely laminated sandy shale.
617.30 - 619.00 - Laminated shaley sandstone.
619.00 - 620.10 - Gray sandy shale.
620.10 - 620.40 - Brown fine grained micaceous sandstone.
620.40 - 620.85 - Laminated sandy shale.
620.85 - 621.00 - Laminated shaley sandstone.
621.00 - 622.05 - Gray shale.
622.05 - 624.70 - Brown fine grained micaceous sandstone.
624.70 - 624.90 - Gray shale.
624.90 - 625.05 - Brown fine grained micaceous sandstone.
625.05 - 625.25 - Laminated sandy shale.
625.25 - 625.45 - Brown fine grained micaceous sandstone.
625.45 - 625.60 - Laminated sandy shale.
625.60 - 626.45 - Brown fine grained micaceous sandstone.
626.45 - 626.60 - Laminated sandstone and shale.
626.60 - 627.35 - Laminated sandy shale.
627.35 - 628.00 - Brown fine grained laminated micaceous shaley
sandstone.
628.00 - 628.65 - Laminated shaley sandstone.

628.65 - 629.05 - Brown fine grained micaceous sandstone.
629.05 - 630.05 - Laminated shale and sandstone.
630.05 - 630.35 - Brown fine grained micaceous sandstone.
630.35 - 631.65 - Laminated shaley sandstone.
631.65 - 633.15 - Gray shale.
633.15 - 633.75 - Laminated shaley sandstone.
633.75 - 634.50 - Gray shale.
634.50 - 636.55 - Soft gray shale.

Coring was started at a depth of 600.50 feet in gray shale and completed at 636.55 feet in soft gray shale. This core shows a total of 16.50 feet of sandstone. For the most part, the pay sand is made up of fine grained micaceous to shaley sandstone. The cored section is badly broken by layers of shale and sandy shale.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are 19.94 and 23.46 millidarcys respectively while that of the pay sand, or that part of the cored section extending from the packer setting to the top of the cement plug, is 22.06 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core has a fair weighted average percent oil saturation, namely, 30.60. The weighted average percent oil saturation of the upper and lower sections are 27.43 and 32.33 respectively. The

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weighted average percent water saturation of the upper and lower sections are 62.03 and 54.35 respectively while that of the pay sand is 59.65 (See Table IV). This gives an overall weighted average total fluid saturation of 90.25 percent.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VII and VIII. From the data given in these tables and on the coregraph, it is evident that some flushing of the sand did occur during coring as some of the sand has a comparatively low chloride content.

The weighted average oil content of the upper and lower sections are 397 and 480 barrels per acre foot respectively while that of the pay sand is 453. The total oil content, as shown by this core, is 6,816 barrels per acre of which 5,644 barrels are in the pay sand section (See Table IV).

LABORATORY FLOODING TESTS

The pay sand in this core responded fairly well to laboratory flooding tests as a total recovery of 1,335 barrels of oil per acre was obtained from 8.40 feet of sand. The weighted average percent oil saturation was reduced from 34.14 to 24.43, or represents an average recovery of 9.69 percent. The weighted average effective permeability of the samples is 3.35 millidarcys while the average initial fluid production pressure is 23.6 pounds per square inch (See Table VI).

From the data given in Table V, you will note that of the 23 samples tested, 14 produced water and 12 oil. This indicates that only

approximately half of the sand represented by these samples is floodable. Furthermore, the tests also show that the sand has a fairly wide variation in effective permeability.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 1,750 barrels of oil per acre, or an average of 208 barrels per acre foot. In calculating this recovery, an allowance was made for oil lost during coring and it is assumed that the true water saturation of the sand is 37 percent.

This core shows approximately 6.4 feet of floodable sand. The principle drawback of this core is the fact that the section is badly broken and has a comparatively wide variation in permeability. In shooting this well, we recommended that a spacer be used from a depth of 614.00 to 621.00 feet and on reporting this shot to Mr. Harris, he advised that the well could be cleaned out much more efficiently if this center zone was shot.

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SHOT RECOMMENDATION

Company Kewanee Oil Company Lease Dandy Well No. 20

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
609.00 - 614.00	5.0	4.5	3.1	15.5
614.00 - 621.00	7.0	3.5	2.0	14.0
621.00 - 629.00	<u>8.0</u>	4.5	3.1	<u>24.8</u>
Total	20.0			54.3

Recommended Packer Setting 606.00 feet
 Note: Plug hole back to 630.00 feet

Oil Field Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company Kewanee Oil Company Lease Sandy Well No. 20

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	601.10	3.1	0.30	0.30	0.93
2	604.63	Imp.	0.31	0.61	0.00
3	605.00	Imp.	0.40	1.01	0.00
4	605.83	24.	0.70	1.71	16.80
5	606.73	27.	0.90	2.61	24.30
6	607.73	Imp.	0.30	3.11	0.00
7	608.35	2.6	0.50	3.61	1.30
8	610.33	Imp.	0.20	3.81	0.00
9	611.00	11.	0.25	4.06	2.73
10	611.30	2.9	0.30	4.36	1.45
11	611.83	11.	0.40	4.96	4.40
12	612.53	28.	0.20	5.16	5.60
13	612.80	34.	0.30	5.46	10.20
14	613.20	21.	0.40	5.86	8.40
15	613.60	48.	0.30	6.16	14.40
16	613.89	40.	0.35	6.51	14.00
17	614.12	27.	0.30	6.81	8.10
18	619.25	10.	0.50	7.31	3.00
19	622.13	14.	0.20	7.51	2.80
20	622.40	18.	0.35	7.86	6.30
21	622.85	32.	0.60	8.36	16.00
22	623.33	29.	0.40	8.76	11.60
23	623.65	26.	0.30	9.06	7.80
24	623.93	17.	0.40	9.46	6.80
25	624.33	34.	0.30	9.76	10.20
26	624.60	33.	0.20	9.96	8.60
27	624.83	22.	0.20	10.16	4.40
28	625.20	6.2	0.20	10.36	1.24
29	625.63	11.	0.20	10.56	2.20
30	625.95	17.	0.30	10.86	5.10
31	626.23	27.	0.35	11.21	9.45
32	626.70	31.	0.40	11.61	12.40
33	630.12	17.	0.30	11.91	5.10

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Keweenaw Oil Company Lease Bandy Well No. 20

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
600.90 - 621.00	5.10	19.94	117.63
622.05 - 631.65	4.60	23.48	107.99
606.00 - 630.00	9.40	22.08	207.59

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RESULTS OF SATURATION TESTS

TABLE III

Company **Kewanee Oil Company** Lease **Bandy** Well No. **20**

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation		Oil Content, Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water		Ft.	Cum. Ft.	
F-1A	601.00	18.3	24.3	-	345	0.30	0.30	104
F-1	603.62	16.1	20.7	-	259	0.20	0.50	52
2	604.79	16.9	24.0	68.3	315	0.75	1.25	236
3	606.02	21.6	30.4	52.0	509	0.70	1.95	356
4	607.32	16.6	18.8	70.4	242	0.90	2.85	218
F-4A	608.25	23.4	45.0	-	617	0.50	3.35	409
F-5	610.38	16.0	31.4	-	390	0.20	3.55	78
5	610.52	21.1	39.7	29.7	650	0.15	3.70	98
6	611.72	16.9	22.8	69.7	299	1.40	5.10	419
7	613.08	21.4	36.1	50.8	633	1.55	6.65	980
8	614.27	16.9	21.6	63.8	283	0.30	6.95	85
9	616.52	18.5	20.9	52.2	300	0.50	7.45	150
10	617.53	14.9	24.9	67.2	288	0.80	8.25	230
11	618.68	14.6	22.6	69.5	256	0.90	9.15	232
F-13	620.92	14.0	29.8	-	324	0.15	9.30	49
14	622.27	20.1	33.4	53.1	520	0.65	9.95	338
15	623.22	19.5	37.4	53.3	566	1.00	10.95	566
16	624.22	20.4	35.5	54.2	562	1.00	11.95	562
F-17	625.37	17.4	30.7	-	414	0.20	12.15	83

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company Kewanee Oil Company Lease Bandy Well No. 20

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.	
F-18	626.36	20.6	40.9	-	-	654	0.95	13.00	555
18	626.52	15.4	23.5	70.6	94.1	281	0.15	13.15	42
19	627.82	16.9	29.4	65.4	94.8	385	0.65	13.80	250
20	628.98	20.6	30.9	45.5	76.4	495	0.40	14.20	198
21	630.28	19.8	40.8	41.6	82.4	628	0.30	14.50	188
F-22	631.58	15.9	21.1	-	-	260	1.30	15.80	338
Total							6.816		6,816

Note: "A" samples were taken from the core after it was received in the laboratory.

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SUMMARY OF SATURATION TESTS

TABLE IV

Company		Lease		Bandy		Well No.	
Kewanee Oil Company						20	
Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre	
600.50 - 621.00	9.30	17.59	27.43	62.03	397	3,696	
622.05 - 631.65	6.50	16.78	38.33	54.38	480	3,120	
606.00 - 630.00	12.45	16.52	30.60	59.65	453	3,644	

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RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Kewanee Oil Company Lease Bandy Well No. 20

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.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1A	601.00	18.3	24.3	345	0.0	0	24.3	60.7	345	6	0.244	45
1	603.62	16.1	20.7	259	0.0	0	20.7	68.9	259	0	Imp.	50+
2	604.62	16.0	25.2	313	0.0	0	25.2	65.0	313	0	Imp.	50+
3	605.87	21.1	30.1	493	7.0	115	23.1	75.3	378	153	5.46	10
4	607.18	16.2	19.8	249	0.0	0	19.8	69.1	249	0	Imp.	50+
4A	608.25	23.4	45.0	817	19.6	356	25.4	63.5	461	170	8.29	10
5	610.38	16.0	31.4	390	0.0	0	31.4	65.9	390	0	Imp.	50+
6	611.53	16.3	24.2	306	2.1	27	22.1	67.2	279	4	0.127	45
7	612.92	22.4	36.4	633	12.3	214	24.1	63.3	419	141	6.10	10
8	614.12	16.1	22.9	286	0.0	0	22.9	61.4	286	0	Imp.	50+
9	616.36	17.0	22.3	294	0.0	0	22.3	64.7	294	0	Imp.	50+
10	617.36	15.4	23.7	283	0.0	0	23.7	72.2	283	0	Imp.	50+
11	618.53	14.3	24.2	268	0.0	0	24.2	68.5	268	0	Imp.	50+
13	620.92	14.0	29.8	324	0.0	0	29.8	60.0	324	114	5.89	25
14	622.12	20.0	34.6	537	5.6	87	29.0	56.6	450	11	0.392	35
15	623.07	20.7	36.5	586	13.6	218	22.9	61.7	368	159	5.83	15
16	624.08	21.2	35.7	588	13.1	216	22.6	63.0	372	51	4.35	15
17	625.37	17.4	30.7	414	4.7	63	26.0	62.5	351	11	0.376	35
18	626.36	20.6	40.9	654	11.2	179	29.7	58.0	475	40	1.66	20
19	627.65	17.4	30.5	412	5.5	74	25.0	50.0	338	4	0.127	45
20	628.82	20.4	31.2	494	9.4	149	21.8	65.3	345	63	2.26	20
21	630.12	20.4	40.2	637	15.2	241	25.0	62.0	396	42	1.24	20
22	631.58	15.9	21.1	260	0.0	0	21.1	52.6	260	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.
"A" samples were taken from the core after it was received in the laboratory.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company	Lease	Well No.
Zenith Oil Company	Bandy	20
Depth Interval, Feet	605.50 - 614.05	622.05 - 630.35
Feet of Core Analyzed	4.15	5.05
Average Percent Porosity	20.25	20.09
Average Percent Original Oil Saturation	32.26	35.62
Average Percent Oil Recovery	8.85	10.43
Average Percent Residual Oil Saturation	23.41	25.19
Average Percent Residual Water Saturation	66.62	59.51
Average Percent Total Residual Fluid Saturation	90.03	84.70
Average Original Oil Content, Bbls./A. Ft.	521.	559.
Average Oil Recovery, Bbls./A. Ft.	151.	166.
Average Residual Oil Content, Bbls./A. Ft.	370.	393.
Total Original Oil Content, Bbls./Acre	2,164.	2,819.
Total Oil Recovery, Bbls./Acre	629.	836.
Total Residual Oil Content, Bbls./Acre	1,535.	1,983.
Average Effective Permeability, Millidarcys	4.24	2.63
Average Initial Fluid Production Pressure, p.s.i.	18.8	25.6
		23.6

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

Oil Field Research Laboratories
RESULTS OF WATER DIFFERENTIATION TESTS
TABLE VII

Company Kewanee Oil Company Lease Bandy Well No. 20

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation	
			Connate	Drilling & Foreign
2	604.79	10,300		
3	606.02	6,800		
4	607.32	11,200		
5	610.52	15,500		
6	611.72	9,500		
7	613.08	5,700		
8	614.27	8,900		
9	616.52	11,400		
10	617.53	10,600		
11	618.68	11,200		
14	622.27	6,300		
15	623.22	7,300		
16	624.22	7,100		
18	626.52	12,100		
19	627.82	10,800		
20	628.98	12,400		
21	630.28	17,000		
Note: ppm - parts per million.				

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company	Kewanee Oil Company	Lease	Bandy	Well No.	20
Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water		
604.55 - 619.00	9,303				
622.05 - 630.35	9,010				
606.00 - 630.00	9,016				

Note: ppm - parts per million.