Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

Location

Section 33 Twp. 20S Rge. 21E County Anderson State Kansas

Name of Sand	Squirrel
Top of Core	601.00
Bottom of Core	637.10
Top of Pay Sand	611.60
Bottom of Sand	628.00
Total Feet of Permeable Sand	13.25

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	0.50	0.50
10 - 20	2.10	2.60
20 - 30	4.65	7.25
30 - 40	3.55	10.80
40 - 50	1.55	12.35
50 & above	0.90	13.25

Average Permeability, Millidarcys	28.57
Average Percent Porosity	20.81
Average Percent Oil Saturation	44.32
Average Percent Water Saturation	44.65
Average Oil Content, Bbls./A. Ft.	716.
Total Oil Content, Bbls./Acre	9,632.
Average Percent Oil Recovery by Laboratory Flooding Tests	16.20
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	262.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	3,443.
Total Calculated Oil Recovery, Bbls./Acre	3,000.
Packer Setting, Feet	611.50
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	

Note: The above averages are for that part of the sand 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:

Depth Interval, Feet	Description
601.00 - 604.90	Gray shale (discarded at well).
604.90 - 605.10	Hard brown fine grained micaceous sandstone.
605.10 - 605.45	Light brown fine grained micaceous sandstone.
605.45 - 605.75	Gray shale.
605.75 - 606.10	Brown fine grained micaceous shaley sandstone.
606.10 - 606.60	Light brown fine grained micaceous sandstone.
606.60 - 607.00	Laminated sandy shale.
607.00 - 607.35	Light brown fine grained laminated micaceous shaley sandstone.
607.35 - 607.60	Laminated sandy shale.
607.60 - 607.90	Light brown fine grained micaceous shaley sandstone.
607.90 - 609.05	Finely laminated sandy shale.
609.05 - 609.35	Light brown fine grained laminated micaceous shaley sandstone.
609.35 - 609.72	Laminated sandy shale.
609.72 - 609.80	Light brown fine grained micaceous shaley sandstone.
609.80 - 610.25	Laminated sandy shale.
610.25 - 610.45	Brown fine grained micaceous sandstone.
610.45 - 610.65	Gray shale.
610.65 - 610.92	Brown fine grained micaceous sandstone.
610.92 - 611.10	Gray sandy shale.
611.10 - 611.25	Brown fine grained finely laminated micaceous shaley sandstone.
611.25 - 611.40	Light brown fine grained micaceous sandstone.

611.40 - 611.60 - Light brown fine grained laminated micaceous shaley sandstone.

611.60 - 613.10 - Brown fine grained micaceous sandstone.

613.10 - 613.75 - Brown fine grained laminated micaceous shaley sandstone.

613.75 - 614.80 - Brown fine grained micaceous sandstone.

614.80 - 615.00 - Finely laminated shaley sandstone.

615.00 - 615.15 - Laminated sandy shale.

615.15 - 615.65 - Brown fine grained micaceous sandstone.

615.65 - 616.45 - Gray sandy shale.

616.45 - 624.75 - Brown fine grained micaceous sandstone.

624.75 - 625.05 - Brown fine grained laminated micaceous carbonaceous sandstone.

625.05 - 625.70 - Gray shale.

625.70 - 628.00 - Brown fine grained micaceous sandstone.

628.00 - 629.00 - Gray shale.

629.00 - 630.15 - Soft gray shale.

630.15 - 633.30 - Gray shale.

633.30 - 634.70 - Light brown fine grained finely laminated micaceous shaley sandstone.

634.70 - 636.35 - Soft gray shale.

636.35 - 637.10 - According to log, black shale (discarded at well).

Coring was started at a depth of 601.00 feet in gray shale and completed at 637.10 feet in dark shale. This core shows a total of 17.34 feet of sand. For the most part, the pay sand is made up of fine grained micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are

17.57 and 29.67 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 28.57 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand has a fairly uniform permeability profile.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core shows a good weighted average percent oil saturation, namely, 44.32. The weighted average percent oil saturation of the upper and lower sections are 39.26 and 44.65 respectively. The weighted average percent water saturation of the upper and lower sections are 42.18 and 46.14 respectively while that of the pay sand is 44.65 (See Table IV). This gives an overall weighted average total fluid saturation of 88.97 percent.

In order 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 for the most part, the zones of higher permeability have the lower chloride content.

The weighted average oil content of the upper and lower sections are 606 and 717 barrels per acre foot respectively while that of the pay sand is 716. The total oil content, as shown by this core, is 10,368 barrels per acre of which 9,632 barrels are in the pay sand section (See Table IV).

LABORATORY FLOODING TESTS

The pay sand in this core responded very well to laboratory flooding tests as a total recovery of 3,443 barrels of oil per acre was obtained from 13.15 feet of sand. The weighted average percent oil saturation was reduced from 44.47 to 28.27, or represents an average recovery of 16.20 percent. The weighted average effective permeability of the samples is 5.75 millidarcys while the average initial fluid production pressure is 16.2 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 17 samples tested, 14 produced oil and water. This indicates that most of the sand represented by these samples is floodable. 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 3,000 barrels of oil per acre. In calculating this recovery, an allowance was made for oil lost during coring and it was assumed that the true water saturation of the sand is 37 percent and that the sand is not pressured up.

This core shows more clean sand than the other cores analyzed by us recently. The sand also is more permeable and has more recoverable oil in place. At the time we reported the shot for this well, we did not know it was a producing well and as a result, we did not recommend as heavy a shot as we would have otherwise.

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SHOT RECOMMENDATION

Company Kewanee Oil Company Lease Kretchmer Well No. 31

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
614.5 - 626.5	12.0	3½	2.0	24.0

Recommended Packer Setting 611.5 feet
Note: Plug hole back to 627.5 feet

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RESULTS OF PERMEABILITY TESTS

TABLE I

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	605.15	22.	0.35	0.35	7.70
2	606.30	1.0	0.50	0.85	0.50
3	607.04	5.1	0.35	1.20	1.79
4	607.70	3.6	0.30	1.50	1.08
5	609.75	Imp.	0.08	1.58	0.00
6	610.27	11.	0.20	1.78	2.20
7	610.75	8.9	0.27	2.05	2.40
8	611.50	8.7	0.20	2.25	1.74
9	611.80	8.2	0.40	2.65	3.28
10	612.15	25.	0.30	2.95	7.50
11	612.50	16.	0.30	3.25	4.80
12	612.75	11.	0.50	3.75	5.50
13	613.80	32.	0.45	4.20	14.40
14	614.37	14.	0.40	4.60	5.60
15	614.75	36.	0.20	4.80	7.20
16	615.50	52.	0.50	5.30	26.00
17	616.75	27.	0.40	5.70	10.80
18	616.95	32.	0.40	6.10	12.80
19	617.50	46.	0.55	6.65	25.30
20	617.95	26.	0.40	7.05	10.40
21	618.40	37.	0.50	7.55	18.50
22	618.95	34.	0.50	8.05	17.00
23	619.45	23.	0.40	8.45	9.20
24	619.85	31.	0.50	8.95	15.50
25	620.28	33.	0.40	9.35	13.20
26	620.68	30.	0.30	9.65	9.00
27	620.95	27.	0.50	10.15	13.50
28	621.60	13.	0.50	10.65	6.50
29	622.15	21.	0.50	11.15	10.50
30	622.55	20.	0.40	11.55	8.00
31	622.85	25.	0.30	11.85	7.50
32	623.15	59.	0.40	12.25	23.60
33	623.80	43.	0.50	12.75	21.50
34	624.15	40.	0.50	13.25	20.00
35	624.55	25.	0.35	13.60	8.75
36	626.05	26.	0.50	14.10	13.00
37	626.35	30.	0.30	14.40	9.00
38	626.70	27.	0.40	14.80	10.80
39	627.10	12.	0.40	15.20	4.80
40	627.50	21.	0.50	15.70	10.50
41	628.00	24.	0.20	15.90	4.80

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
604.90 - 615.65	5.22	17.57	91.69
616.45 - 628.00	10.60	29.67	314.45
611.50 - 627.50	13.25	28.57	378.50

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RESULTS OF SATURATION TESTS

TABLE III

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

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-1A	604.94	18.7	31.9	-	-	462	0.20	0.20	93
1	605.96	14.8	29.1	46.0	75.1	334	0.35	0.55	117
3	609.28	14.6	30.8	56.5	87.3	349	0.30	0.85	105
F-5	611.18	15.7	32.2	-	-	392	0.15	1.00	59
5	611.32	17.2	26.0	53.7	79.7	347	0.15	1.15	52
6	612.42	21.0	44.5	39.4	83.9	724	1.50	2.65	1,086
7	614.13	21.1	43.0	39.4	82.4	704	1.05	3.70	740
8	615.22	21.0	36.9	41.5	78.4	601	0.50	4.20	300
9	616.52	20.2	43.8	44.9	88.7	686	0.95	5.15	651
10	618.22	21.6	45.7	46.9	92.6	766	1.30	6.45	996
11	619.22	20.3	45.9	41.3	87.2	725	1.00	7.45	725
12	620.17	21.6	45.8	37.4	73.2	767	1.00	8.45	767
13	621.22	21.0	46.0	48.7	94.7	750	1.10	9.55	825
14	622.42	20.5	43.3	47.4	90.7	699	1.20	10.75	839
15	623.58	21.5	44.2	51.3	95.5	736	1.75	12.50	1,290
16	624.97	18.6	36.8	44.7	81.5	532	0.30	12.80	160
17	625.92	20.4	44.8	47.6	92.4	710	0.80	13.60	569
18	626.97	19.2	47.0	46.5	94.5	700	0.80	14.40	560
19	627.78	19.0	42.0	47.4	89.4	620	0.70	15.10	434
							Total	- - - -	10,368

Note: "A" sample was drilled from the core after it was received in the laboratory.

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SUMMARY OF SATURATION TESTS

TABLE IV

Company Kewanee Oil Company Lease Fretchner 100 Acres Well No. 31

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
604.90-615.65	4.20	19.91	39.26	42.18	608	2,552
616.45-628.00	10.90	20.65	44.65	46.14	717	7,816
611.50-627.50	13.45	20.81	44.32	44.65	716	9,632

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RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Keystone Oil Company Lease Kretchmer 100 Acres Well No. 1 S1

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	604.34	18.7	31.9	462	4.7	68	27.2	68.4	394	80	2.46	20
1	605.93	14.1	32.3	353	0.0	0	32.3	64.0	353	0	Imp.	50+
3	609.12	14.0	30.0	326	0.0	0	30.0	66.7	326	0	Imp.	50+
5	611.18	15.7	35.2	398	0.0	0	32.2	64.1	398	0	Imp.	50+
6	612.25	20.5	44.0	700	22.8	365	21.2	73.0	337	115	5.06	10
7A	614.50	22.2	48.7	739	9.5	144	33.2	61.8	571	135	5.07	15
8A	615.50	23.0	37.0	631	9.9	168	27.5	63.9	460	80	10.79	15
9A	616.65	20.8	44.5	718	14.8	234	30.0	63.4	484	93	4.63	15
10	618.08	21.7	42.9	722	16.1	254	27.8	66.7	468	76	18.30	10
11	619.08	20.9	43.6	707	17.2	279	26.4	69.4	428	127	5.54	15
12	620.63	21.3	46.9	776	24.4	404	22.5	57.5	372	71	1.68	15
13	621.07	19.8	47.1	734	19.1	294	28.0	66.7	430	83	3.57	15
14	622.27	20.6	44.6	713	14.9	238	29.7	64.0	475	69	4.16	15
15A	623.70	21.1	45.7	749	12.1	198	33.6	63.7	551	40	7.09	10
17	625.76	20.3	44.2	698	12.7	200	31.5	60.3	496	21.5	1.10	25
18	626.85	20.4	46.7	739	21.3	337	25.4	68.7	402	130	3.68	15
19	627.62	18.7	45.6	820	6.1	118	34.5	60.5	502	45	0.804	30

Note: 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 drilled from the core after it was received in the laboratory.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

Depth Interval, Feet	604.90 - 615.65	616.45 - 628.00	611.50-627.50
Feet of Core Analyzed	3.25	10.60	13.15
Average Percent Porosity	21.20	20.71	20.94
Average Percent Original Oil Saturation	41.75	44.97	44.47
Average Percent Oil Recovery	15.35	15.86	16.20
Average Percent Residual Oil Saturation	26.40	29.11	28.27
Average Percent Residual Water Saturation	67.69	62.79	64.01
Average Percent Total Residual Fluid Saturation	94.09	91.90	92.28
Average Original Oil Content, Bbls./A. Ft.	687.	722.	721.
Average Oil Recovery, Bbls./A. Ft.	250.	255.	262.
Average Residual Oil Content, Bbls./A. Ft.	437.	467.	459.
Total Original Oil Content, Bbls./Acre	2,231.	7,652.	9,479.
Total Oil Recovery, Bbls./Acre	812.	2,704.	3,443.
Total Residual Oil Content, Bbls./Acre	1,419.	4,948.	6,036.
Average Effective Permeability, Millidarcys	4.87	5.73	5.75
Average Initial Fluid Production Pressure, p.s.i.	15.0	16.5	16.2

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

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RESULTS OF WATER DIFFERENTATION TESTS

TABLE VII

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	605.96	16,200			
3	609.28	11,000			
5	611.32	10,300			
6	612.42	9,000			
7	614.13	10,600			
8	615.22	8,600			
9	616.52	6,200			
10	618.22	6,600			
11	619.22	6,200			
12	620.17	13,900			
13	621.22	5,900			
14	622.42	5,700			
15	623.58	7,000			
16	624.97	10,200			
17	625.92	6,600			
18	626.97	7,200			
19	627.78	8,000			

Note: ppm - parts per million

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SUMMARY OF WATER DIFFERENTATION TESTS

TABLE VIII

Company Kewanee Oil Company Lease Kretchmer 100 Acres Well No. 31

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
605.75 - 615.65	10,237		
616.45 - 628.00	7,328		
611.50 - 627.50	7,790		

Note: ppm - parts per million