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

OILFIELD RESEARCH LABORATORIES

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May 1, 1962

Well-Kan Oil Company
Richmond, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Cable Tool core taken from the Ester Holtman Lease, Well No. 2, Crawford County, Kansas, and submitted to our laboratory on April 25, 1962.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:rf

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GENERAL INFORMATION & SUMMARY

Company Wel-Kan Oil Co. Lease Ester Holtman Well No. 2

Location NE¼

Section 2 Twp. 28S Rge. 23E County Crawford State Kansas

Name of Sand	Peru
Top of Core	173.6
Bottom of Core	202.3
Top of Oil Sand	176.0
Bottom of Sand	201.5
Total Feet of Permeable Sand	25.5
Total Feet of Floodable Sand	20.3

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	2.9	2.9
5 - 10	3.0	5.9
10 - 20	12.6	18.5
20 - 25	6.0	24.5
25 & above	1.0	25.5

Average Permeability Millidarcys	16.1
Average Percent Porosity	17.6
Average Percent Oil Saturation	35.5
Average Percent Water Saturation	49.8
Average Oil Content, Bbls./A. Ft.	486.
Total Oil Content, Bbls./Acre	12,405.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.5
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	90.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,922.
Total Calculated Oil Recovery, Bbls./Acre (Primary)	548.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

The sand was cored in water. This well was drilled in a virgin area. The core was sampled and sealed in tin cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
173.6 - 175.0	Soft shale.
175.0 - 176.0	Gray and brown calcareous sandstone.
176.0 - 178.0	Brown, slightly calcareous sandstone.
178.0 - 179.0	Brown, conglomeratic sandstone.
179.0 - 201.5	Brown, fine grained, slightly calcareous sandstone.
201.5 - 202.3	Limestone.

Coring was started at a depth of 173.6 feet in soft shale and completed at 202.3 feet in limestone. This core shows a total of 26.5 feet of sandstone. For the most part, the pay is made up of brown, fine grained, slightly 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 9.6, 19.8 and 19.2 millidarcys respectively; the overall average being 16.1 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a comparatively uniform permeability profile. The permeability of the sand varies from 2.7 to a maximum of 49. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 35.5. The weighted average percent oil saturation of the upper, middle and lower sections is 34.7, 38.2 and 30.4 respectively. The weighted average percent water saturation of the upper,

middle and lower sections is 50.4, 48.6 and 50.0 respectively; the overall average being 49.8 (See Table III). This gives an overall weighted average total fluid saturation of 85.3 percent.

The weighted average oil content of the upper, middle and lower sections is 484, 509 and 463 barrels per acre foot respectively; the overall average being 486. The total oil content, as shown by this core, is 12,405 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

At comparatively high pressures, the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 1,922 barrels of oil per acre was obtained from 21.3 feet of sand. The weighted average percent oil saturation was reduced from 36.5 to 30.0, or represents an average recovery of 6.5 percent. The weighted average effective permeability of the samples is 0.309 millidarcys, while the average initial fluid production pressure is 36.8 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 26 samples tested, 25 produced water and 22 oil. This indicates that approximately 85 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a comparatively uniform and low effective permeability.

CONCLUSION

On the basis of the above data, it is evident that approximately 548 barrels of oil per acre can be recovered from the area, represented by this core, by efficient primary production methods. An additional oil recovery of approximately 3,023 barrels of oil per acre can be expected by efficient water-flooding provided satisfactory water injection rates can be maintained throughout the life of the flood. This is equivalent to an average of 149 barrels per acre foot. In calculating the above recovery values, the following data and assumptions were employed:

Formation volume factor	1.02
Primary oil recovery	None.
Irreducible water saturation, percent	43.0
Present oil saturation, percent	54.4
Oil saturation after flooding, percent	30.0
Percent porosity	17.7
Performance factor	0.45
Reported A.P.I. gravity, degrees	31.0
Feet of pay sand	20.3

This core shows a clean sand section having a fairly good oil saturation, a rather high water saturation and a low permeability.

Because of the tightness of the sand, for its depth, it is suggested that intake capacity of a well be tested before water-flooding is initiated.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Wel-Kan Oil Co. **Lease** E. Holtman **Well No.** 2

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	176.3	16.6	38	54	92	489	4.1	0.7	0.7	342	3.87
2	177.1	16.8	25	53	78	326	3.3	1.3	2.0	424	4.29
3	178.1	16.7	30	57	87	389	9.9	1.0	3.0	389	9.90
4	179.1	18.7	36	51	87	522	13.	0.6	3.6	313	7.80
5	180.1	18.4	43	48	91	614	14.	1.0	4.6	614	14.00
6	181.1	18.5	34	48	82	488	16.	1.0	5.6	488	16.00
7	182.1	19.4	36	46	82	542	7.7	1.0	6.6	542	7.70
8	183.1	17.1	39	52	91	518	11.	1.0	7.6	518	11.00
9	184.1	19.2	36	49	85	536	7.6	1.0	8.6	536	7.60
10	185.1	18.6	31	52	83	447	16.	1.0	9.6	447	16.00
11	186.1	18.2	36	48	84	508	19.	1.0	10.6	508	19.00
12	187.1	17.2	37	51	88	494	16.	1.0	11.6	494	16.00
13	188.1	16.2	43	45	88	560	19.	1.0	12.6	560	19.00
14	189.1	16.2	42	49	91	528	15.	1.0	13.6	528	15.00
15	190.1	16.8	43	48	91	560	23.	1.0	14.6	560	23.00
16	191.1	17.2	38	51	89	507	24.	1.0	15.6	507	24.00
17	192.1	16.8	37	47	84	482	23.	1.0	16.6	482	23.00
18	193.1	17.2	37	46	83	494	23.	1.0	17.6	494	23.00
19	194.1	17.8	35	47	82	484	13.	1.0	18.6	484	13.00
20	195.1	17.8	31	53	84	428	16.	1.0	19.6	428	16.00
21	196.1	17.4	35	54	89	473	14.	1.0	20.6	473	14.00
22	197.1	18.1	33	50	83	463	14.	1.0	21.6	463	14.00
23	198.1	19.7	33	48	81	504	23.	1.0	22.6	504	23.00
24	199.1	18.2	33	46	79	466	49.	1.0	23.6	466	49.00
25	200.1	17.3	32	55	87	430	20.	1.0	24.6	430	20.00
26	201.1	16.8	35	47	82	456	2.7	0.9	25.5	411	2.43
								Total	-------	12,405	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Wel-Kan Oil Co. Lease Ester Holtman Well No. 2

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
176.0 - 184.6	8.6	9.6	82.16
184.6 - 193.6	9.0	19.8	178.00
193.6 - 201.5	7.9	19.2	151.43
176.0 - 201.5	25.5	16.1	411.59

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
176.0 - 184.6	8.6	17.9	34.7	50.4	484	4,166
184.6 - 193.6	9.0	17.2	38.2	48.6	509	4,580
193.6 - 201.5	7.9	17.9	30.4	50.0	463	3,659
176.0 - 201.5	25.5	17.6	35.5	49.8	486	12,405

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Wel-Kan Oil Co. Lease Ester Holtman Well No. 2

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	176.3	17.0	38	501	6	79	32	66	422	6	0.167	45
2	177.1	16.2	26	327	0	0	26	67	327	7	0.064	40
3	178.1	16.3	28	354	0	0	28	62	354	0	Imp.	-
4	179.1	19.1	36	533	10	148	26	67	385	9	0.221	45
5	180.1	18.7	43	624	15	218	28	67	406	12	0.200	20
6	181.1	18.0	34	475	4	56	30	65	419	11	0.137	40
7	182.1	19.0	36	531	8	118	28	68	413	6	0.163	45
8	183.1	17.5	37	502	7	95	30	62	407	7	0.135	45
9	184.1	19.4	36	541	9	135	27	71	406	75	1.20	20
10	185.1	18.6	31	447	5	72	26	70	375	14	0.240	30
11	186.1	18.6	36	520	9	130	27	67	390	8	0.167	40
12	187.1	17.1	37	491	10	133	27	72	358	26	0.510	20
13	188.1	16.6	43	553	13	167	30	65	386	13	0.270	30
14	189.1	15.9	42	518	4	49	38	57	469	9	0.260	40
15	190.1	16.3	43	544	9	114	34	63	430	10	0.180	40
16	191.1	16.9	38	498	6	79	32	62	419	10	0.200	40
17	192.1	17.1	37	491	8	106	29	67	385	38	1.05	30
18	193.1	16.6	37	476	5	64	32	61	412	7	0.183	45
19	194.1	17.2	35	467	1	13	34	62	454	4	0.087	45
20	195.1	17.4	31	418	2	27	29	64	391	12	0.230	30
21	196.1	17.3	35	469	3	40	32	64	429	8	0.153	45
22	197.1	18.1	33	463	3	42	30	61	421	4	0.163	50
23	198.1	19.5	33	500	5	76	28	65	424	15	0.553	40
24	199.1	18.7	33	480	3	44	30	64	436	18	0.205	30
25	200.1	17.7	31	426	0	0	31	59	426	4	0.163	50
26	201.1	16.5	32	410	0	0	32	55	410	3	0.083	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.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Wel-Kan Oil Co. **Lease** Ester Holtman **Well No.** 2

Depth Interval, Feet	176.0 - 184.6	184.6 - 193.6	193.6 - 199.6	176.0 - 199.6
Feet of Core Analyzed	6.3	9.0	6.0	21.3
Average Percent Porosity	18.4	17.1	18.0	17.7
Average Percent Original Oil Saturation	36.1	38.3	33.3	36.5
Average Percent Oil Recovery	7.4	7.7	2.8	6.5
Average Percent Residual Oil Saturation	28.7	30.6	30.5	30.0
Average Percent Residual Water Saturation	66.6	64.9	63.4	65.0
Average Percent Total Residual Fluid Saturation	95.3	95.5	93.9	95.0
Average Original Oil Content, Bbls./A. Ft.	531.	505.	466.	501.
Average Oil Recovery, Bbls./A. Ft.	122.	102.	40.	90.
Average Residual Oil Content, Bbls./A. Ft.	409.	403.	426.	411.
Total Original Oil Content, Bbls./Acre	3,344.	4,538.	3,797.	10,679.
Total Oil Recovery, Bbls./Acre	766.	914.	242.	1,922.
Total Residual Oil Content, Bbls./Acre	2,578.	3,624.	2,555.	8,757.
Average Effective Permeability, Millidarcys	0.331	0.34	0.24	0.309
Average Initial Fluid Production Pressure, p.s.i.	36.3	35.0	40.0	36.8

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