

OILFIELD RESEARCH LABORATORIES

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September 7, 1966

13-22-22E
Kingwood Oil Company
1470 First National Building
Oklahoma City, Oklahoma

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Paddock Lease, Well No. 1, Linn County, Kansas, and submitted to our laboratory on September 1, 1966.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman
Benjamin R. Pearman

BRP:rf

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Paddock 1

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GENERAL INFORMATION & SUMMARY

Company	Kingwood Oil Company		Lease	Paddock		Well No.	1
Location	660' NSL & 1100' EWL NW						
Section	13	Twp.	22S	Rge.	22E	County	Linn
						State	Kansas
Name of Sand							Bartlesville
Top of Core							695.0
Bottom of Core							730.0
Top of Sand							703.0
Bottom of Sand							725.6
Total Feet of Permeable Sand							17.7
Total Feet of Floodable Sand							3.4
Distribution of Permeable Sand:							
Permeability Range		Feet		Cum. Ft.			
Millidarcys							
7 - 20		6.5		6.5			
20 - 50		5.0		11.5			
50 - 100		4.2		15.7			
100 & above		2.0		17.7			
Average Permeability Millidarcys							49.0
Average Percent Porosity							20.6
Average Percent Oil Saturation							41.6
Average Percent Water Saturation							40.1
Average Oil Content, Bbls./A. Ft.							666.
Total Oil Content, Bbls./Acre							12,876.
Average Percent Oil Recovery by Laboratory Flooding Tests							6.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.							112.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre							381.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)							1,360.
Packer Setting, Feet							
Viscosity, Centipoises @							
A. P. I. Gravity, degrees @ 60 °F							
Elevation, Feet (Ground Level)							1030.5

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories. The well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

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

695.0 - 699.0 - Calcareous sandy shale.
699.0 - 702.5 - Gray, finely laminated, shaly sandstone.
702.5 - 703.0 - Gray shaly sandstone.
703.0 - 708.0 - Grayish brown, fine grained sandstone with a shale streak at 708.0.
708.0 - 710.3 - Brown, fine grained, slightly shaly sandstone.
710.3 - 712.5 - Dark, fine grained, slightly shaly sandstone.
712.5 - 713.5 - Gray sandy shale.
713.5 - 714.2 - Dark, laminated, shaly sandstone.
714.2 - 717.9 - Dark, fine grained sandstone.
717.9 - 718.2 - Dark, laminated, shaly sandstone.
718.2 - 719.0 - Gray, laminated, sandy shale.
719.0 - 722.5 - Dark, laminated, shaly sandstone.
722.5 - 724.0 - Gray sandy shale.
724.0 - 725.6 - Dark, fine grained sandstone.
725.6 - 726.6 - Dark, agglomeratic sandstone.
726.6 - 730.0 - Gray, laminated, sandy shale.

Coring was started at a depth of 695.0 feet in calcareous sandy shale and completed at 730.0 feet in gray, laminated, sandy shale.

For the most part, the pay is made up of brown to dark, 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 55.5 and 46.2 millidarcys respectively; the overall average being 49.0 (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 impermeable to a maximum of 177. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 41.6. The weighted average percent oil saturation of the upper and lower sections is 14.4 and 51.1 respectively. The weighted average percent water saturation of the upper and lower sections is 60.8 and 32.8 respectively; the overall average being 40.1 (See Table III). This gives an overall weighted average total fluid saturation of 81.7 percent.

The weighted average oil content of the upper and lower sections is 230 and 820 barrels per acre foot respectively; the overall average being 666. The total oil content, as shown by this core, is 12,876 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded rather poorly to laboratory flooding tests, as a total recovery of 381 barrels of oil per acre was

obtained from 3.4 feet of sand. The weighted average percent oil saturation was reduced from 50.7 to 43.9, or represents an average recovery of 6.8 percent. The weighted average effective permeability of the samples is 0.468 millidarcys, while the average initial fluid production pressure is 45.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 22 samples tested, 15 produced water and 4 oil. This indicates that approximately 18 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a wide variation in effective permeability to water.

CONCLUSION

The results of the laboratory tests indicate that efficient primary and secondary operations in the vicinity of this well should recover approximately 1,360 barrels of oil per acre or an average of 243 barrels per acre foot from 5.6 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.04
Reservoir water saturation, percent	25.0
Primary recovery, estimated, percent	None
Average porosity, percent	21.0
Oil saturation after flooding, percent	43.9
Performance factor, percent	50.0
Net floodable pay sand, feet	5.6

This core shows a pay sand section having a good oil saturation,

a moderate water saturation and a wide variation in effective permeability to water.

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

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Kingwood Oil Company Lease Paddock Well No. 1

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	703.1	19.5	19	54	73	287	15.	0.6	0.6	172	9.00
2	704.1	21.1	10	63	73	164	47.	1.0	1.6	164	47.00
3	705.1	19.3	17	62	79	254	19.	1.0	2.6	254	19.00
4	706.1	21.2	11	57	68	181	75.	1.0	3.6	181	75.00
5	707.1	21.8	16	64	80	270	92.	1.4	5.0	378	128.80
6	708.1	17.9	24	50	74	333	39.	0.6	5.6	200	23.40
7	709.1	18.8	46	44	90	671	36.	1.0	6.6	671	36.00
8	710.1	18.8	35	46	81	510	7.6	0.7	7.3	357	5.32
9	711.1	21.8	52	25	77	879	58.	1.2	8.5	1,053	69.60
10	712.1	20.1	48	38	86	747	17.	1.0	9.5	747	17.00
11	713.6	19.4	52	39	91	781	Imp.	0.7	10.2	547	0.00
12	714.3	23.4	46	30	76	834	30.	0.5	10.7	417	15.00
13	715.1	20.8	42	37	79	677	Imp.	0.9	11.6	608	0.00
14	716.1	22.0	73	15	88	1,246	112.	1.0	12.6	1,246	112.00
15	717.2	22.4	70	21	91	1,218	20.	1.3	13.9	1,583	26.00
16	718.1	16.9	58	21	79	759	14.	0.3	14.2	228	4.20
17	719.1	19.5	48	36	84	726	11.	0.6	14.8	436	6.66
18	720.1	18.6	59	32	91	851	25.	1.0	15.8	851	25.00
19	721.1	19.0	37	46	83	545	16.	1.0	16.8	545	16.00
20	722.1	20.2	46	28	74	719	24.	0.9	17.7	647	21.60
21	724.1	22.0	48	33	81	819	55.	0.6	18.3	491	33.00
22	725.1	22.9	62	27	89	1,100	177.	1.0	19.3	1,100	177.00
								Total	-----	12,876	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Kingwood Oil Company Lease Paddock Well No. 1

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
703.0 - 708.0	5.0	55.5	278.80
708.0 - 725.6	12.7	46.2	587.78
703.0 - 725.6	17.7	49.0	866.58

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
703.0 - 708.0	5.0	20.8	14.4	60.8	230	1,149
708.0 - 725.6	14.3	20.4	51.1	32.8	820	11,727
703.0 - 725.6	19.3	20.6	41.6	40.1	666	12,876

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Kingwood Oil Company Lease Paddock Well No. 1

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	703.1	19.2	19	283	0	0	19	65	283	8	0.300	50
2	704.1	20.7	8	128	0	0	8	86	128	329	7.70	20
3	705.1	19.8	15	230	0	0	15	77	230	47	1.00	30
4	706.1	21.6	14	234	0	0	14	76	234	430	9.60	20
5	707.1	21.8	15	254	0	0	15	79	254	184	6.10	10
6	708.1	18.4	23	328	0	0	23	61	328	22	0.600	30
7	709.1	19.3	46	688	4	60	42	56	628	8	0.200	50
8	710.1	19.0	36	530	0	0	36	52	530	6	0.200	50
9	711.1	21.5	53	883	0	0	53	26	883	0	Imp.	-
10	712.1	20.5	48	763	0	0	48	40	763	0	Imp.	-
11	713.6	19.7	52	794	0	0	52	41	794	0	Imp.	-
12	714.3	23.0	46	820	6	107	40	44	713	9	0.300	50
13	715.1	20.6	44	702	0	0	44	37	702	0	Imp.	-
14	716.1	22.0	73	1,244	0	0	73	16	1,244	0	Imp.	-
15	717.2	22.0	72	1,228	0	0	72	20	1,228	0	Imp.	-
16	718.1	16.7	59	763	0	0	59	23	763	0	Imp.	-
17	719.1	20.0	48	744	0	0	48	40	744	8	0.200	50
18	720.1	18.2	59	833	0	0	59	37	833	7	0.200	50
19	721.1	19.1	39	576	0	0	39	50	576	8	0.200	50
20	722.1	20.2	46	721	9	141	37	57	580	8	0.200	50
21	724.1	21.7	48	808	0	0	48	48	808	9	0.200	50
22	725.1	22.5	62	1,082	8	140	54	36	942	46	1.06	30

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	Kingwood Oil Company	Lease	Paddock	Well No.	1
Depth Interval, Feet	708.0 - 725.6				
Feet of Core Analyzed	3.4				
Average Percent Porosity	21.0				
Average Percent Original Oil Saturation	50.7				
Average Percent Oil Recovery	6.8				
Average Percent Residual Oil Saturation	43.9				
Average Percent Residual Water Saturation	48.6				
Average Percent Total Residual Fluid Saturation	92.5				
Average Original Oil Content, Bbls./A. Ft.	832.				
Average Oil Recovery, Bbls./A. Ft.	112.				
Average Residual Oil Content, Bbls./A. Ft.	720.				
Total Original Oil Content, Bbls./Acre	2,830.				
Total Oil Recovery, Bbls./Acre	381.				
Total Residual Oil Content, Bbls./Acre	2,449.				
Average Effective Permeability, Millidarcys	0.468				
Average Initial Fluid Production Pressure, p.s.i.	45.0				

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