OILFIELD RESEARCH LABORATORIES
536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

February 10, 1967

CRA, Incorporated
P.O. Box 98
Wellington, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core samples taken from the Humphrey Lease, Well No. CT-4, Bourbon County, Kansas, and submitted to our laboratory on February 7, 1967.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

BRP:rf

3 c. - Wellington, Kansas
1 c. - Muskogee, Oklahoma
1 c. - Roy Wood

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company CRA, Incorporated Lease Humphrey Well No. CT-4

Location 1620' NSL & 490' EWL, SE¼

Section 36 Twp. 24S Rge. 21E County Bourbon State Kansas

Name of Sand	Bartlesville
Top of Core	637.0
Bottom of Core	655.0
Top of Sand (Received)	637.0
Bottom of Sand (Received)	655.0
Total Feet of Permeable Sand	18.0
Total Feet of Floodable Sand	12.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
1 - 5	5.0	5.0
5 - 10	2.0	7.0
10 - 20	3.0	10.0
20 - 50	7.0	17.0
50 & above	1.0	18.0

Average Permeability Millidarcys	21.2
Average Percent Porosity	18.5
Average Percent Oil Saturation	38.0
Average Percent Water Saturation	43.0
Average Oil Content, Bbls./A. Ft.	549.
Total Oil Content, Bbls./Acre	9,863.
Average Percent Oil Recovery by Laboratory Flooding Tests	8.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	132.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,587.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	3,370.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	1031.2

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples, sealed in plastic bags, were submitted to the laboratory by a representative of the client. The well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
637.0 - 638.0	Light brown, laminated, shaly sandstone.
638.0 - 640.0	Brown sandstone.
640.0 - 641.0	Brown, micaceous sandstone.
641.0 - 643.0	Light brown, micaceous sandstone.
643.0 - 645.0	Brown sandstone.
645.0 - 647.0	Light brown, micaceous sandstone.
647.0 - 651.0	Brown, slightly conglomeratic sandstone.
651.0 - 652.0	Light brown, laminated, shaly sandstone.
652.0 - 655.0	Brown, slightly carbonaceous, slightly shaly sandstone.

The pay is made up of brown to light brown, more or less, 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 is 24.8 and 11.8 millidarcys respectively; the overall average being 21.2 (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 1.4 to a maximum of 86. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 38.0. The weighted average percent oil saturation of the upper and lower sections is 36.6 and 41.6 respectively. The weighted average percent water saturation of the upper and lower sections is 46.4 and 34.0 respectively; the overall average being 43.0 (See Table III). This gives an overall weighted average total fluid saturation of 81.0 percent.

The weighted average oil content of the upper and lower sections is 522 and 614 barrels per acre foot respectively; the overall average being 549. The total oil content, as shown by this core, is 9,863 barrels per acre of which 6,541 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 1,587 barrels of oil per acre was obtained from 12.0 feet of sand. The weighted average percent oil saturation was reduced from 37.4 to 28.6, or represents an average recovery of 8.8 percent. The weighted average effective permeability of the samples is 0.800 millidarcys, while the average initial fluid production pressure is 29.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 18 samples tested, 13 produced water and 12 oil. This indicates that approximately 67 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 3,370 barrels of oil per acre or an average of 281 barrels per acre foot from the 12.0 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.06
Reservoir water saturation, percent	30.0
Average porosity, percent	18.6
Oil saturation after flooding, percent	28.6
Performance factor, percent	50.0
Net floodable pay sand, feet	12.0

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.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company CRA, Incorporated Lease Humphrey Well No. CT-4

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	637.1	17.3	37	38	75	496	13.	1.0	1.0	496	13.00
2	638.1	18.7	37	43	80	536	29.	1.0	2.0	536	29.00
3	639.1	19.6	34	43	77	516	23.	1.0	3.0	516	23.00
4	640.1	16.1	26	62	88	325	42.	1.0	4.0	325	42.00
5	641.1	16.1	26	64	90	325	2.2	1.0	5.0	325	2.20
6	642.1	17.8	42	56	98	579	3.3	1.0	6.0	579	3.30
7	643.1	17.0	31	54	85	408	18.	1.0	7.0	408	18.00
8	644.1	18.4	34	45	79	484	86.	1.0	8.0	484	86.00
9	645.1	19.0	42	42	84	619	6.1	1.0	9.0	619	6.10
10	646.1	17.1	40	52	92	530	3.5	1.0	10.0	530	3.50
11	647.1	19.4	41	35	76	616	29.	1.0	11.0	616	29.00
12	648.1	20.8	41	36	77	661	25.	1.0	12.0	661	25.00
13	649.1	20.1	45	34	79	701	42.	1.0	13.0	701	42.00
14	650.1	19.1	38	27	65	562	37.	1.0	14.0	562	37.00
15	651.1	18.5	32	41	73	459	12.	1.0	15.0	459	12.00
16	652.1	19.7	41	35	76	626	6.6	1.0	16.0	626	6.60
17	653.1	20.0	48	37	85	745	2.2	1.0	17.0	745	2.20
18	654.1	17.8	49	30	79	675	1.4	1.0	18.0	675	1.40
								Total	-------	9,863	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company CRA, Incorporated Lease Humphrey Well No. CT-4

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
637.0 - 650.0	13.0	24.8	322.10
650.0 - 655.0	5.0	11.8	59.20
637.0 - 655.0	18.0	21.2	381.30

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
637.0 - 650.0	13.0	18.2	36.6	46.4	522	6,796
650.0 - 655.0	5.0	19.0	41.6	34.0	614	3,067
637.0 - 655.0	18.0	18.5	38.0	43.0	549	9,863

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company CRA, Incorporated Lease Humphrey Well No. CT-4

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	637.1	17.3	37	496	8	107	29	66	389	5	0.200	40
2	638.1	19.2	37	550	10	149	27	64	401	45	0.900	20
3	639.1	19.3	34	509	7	105	27	69	404	25	0.500	20
4	640.1	16.5	26	332	2	26	24	75	306	16	0.400	30
5	641.1	16.0	26	322	0	0	26	66	322	0	Imp.	-
6	642.1	18.2	42	592	6	85	36	63	507	4	0.200	50
7	643.1	17.5	31	420	3	41	28	70	379	23	0.500	30
8	644.1	18.9	34	499	9	132	25	69	367	180	3.50	10
9	645.1	18.7	42	609	8	116	34	62	493	9	0.300	50
10	646.1	17.5	40	542	2	27	38	60	515	6	0.200	50
11	647.1	19.9	41	633	16	247	25	74	386	39	1.10	20
12	648.1	20.5	41	651	15	238	26	72	413	33	0.900	20
13	649.1	20.3	45	708	20	314	25	74	394	38	0.900	10
14	650.1	18.9	39	571	0	0	39	29	571	0	Imp.	-
15	651.1	18.5	31	444	0	0	31	44	444	0	Imp.	-
16	652.1	19.7	41	626	0	0	41	39	626	3	0.100	50
17	653.1	19.8	49	753	0	0	49	38	753	0	Imp.	-
18	654.1	18.0	49	683	0	0	49	32	683	0	Imp.	-

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 CRA, Incorporated Lease Humphrey Well No. CT-4

Depth Interval, Feet	637.0 - 650.0
Feet of Core Analyzed	12.0
Average Percent Porosity	18.6
Average Percent Original Oil Saturation	37.4
Average Percent Oil Recovery	8.8
Average Percent Residual Oil Saturation	28.6
Average Percent Residual Water Saturation	68.1
Average Percent Total Residual Fluid Saturation	96.7
Average Original Oil Content, Bbls./A. Ft.	545.
Average Oil Recovery, Bbls./A. Ft.	132.
Average Residual Oil Content, Bbls./A. Ft.	413.
Total Original Oil Content, Bbls./Acre	6,541.
Total Oil Recovery, Bbls./Acre	1,587.
Total Residual Oil Content, Bbls./Acre	4,954.
Average Effective Permeability, Millidarcys	0.800
Average Initial Fluid Production Pressure, p.s.i.	29.2

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