



OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS 66720 - PHONE (316) 431-2650

January 4, 1978

Synergy Oil Company
c/o Diehl, Fletcher, & Banwart
910 West Elm
Chanute, Kansas 66720

Gentlemen:

Enclosed herewith is the report of the analysis run on the Rotary core taken from the ZumMallen Lease, Well No. I-3, Crawford County, Kansas, and submitted to our laboratory on December 22, 1977.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman
Benjamin R. Pearman

BRP:vm
5 c to Chanute, Kansas

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Synergy Oil Company Lease ZumMallen Well No. I-3

Location 3208' WEL & 855' SNL

Section 36 Twp. 28S Rge. 21E County Crawford State Kansas

Name of Sand	Bartlesville
Top of Core	413.0
Bottom of Core	434.0
Top of Sand	413.0
Bottom of Sand	430.7
Total Feet of Permeable Sand	16.7
Total Feet of Floodable Sand	6.4

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	6.7	6.7
5 - 10	4.3	11.0
10 - 40	4.0	15.0
40 & above	1.7	16.7

Average Permeability Millidarcys	13.4
Average Percent Porosity	16.4
Average Percent Oil Saturation	34.1
Average Percent Water Saturation	50.0
Average Oil Content, Bbls./A. Ft.	451.
Total Oil Content, Bbls./Acre	7,539.
Average Percent Oil Recovery by Laboratory Flooding Tests	8.3
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	118.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	755.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	1,270.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

OILFIELD RESEARCH LABORATORIES

- 2 -

This well was drilled in non-virgin territory. Fresh water mud was used as the circulating fluid while taking the core. The core was sampled by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
413.0 - 414.9	Grayish light brown laminated shaly sandstone.
414.9 - 415.3	Gray sandy shale.
415.3 - 417.1	Grayish light brown laminated shaly sandstone.
417.1 - 417.5	Gray sandy shale.
417.5 - 419.2	Grayish brown shaly sandstone.
419.2 - 421.3	Grayish light brown laminated shaly sandstone.
421.3 - 422.7	Grayish brown slightly shaly sandstone.
422.7 - 424.2	Grayish light brown shaly sandstone.
424.2 - 424.4	Gray sandy shale.
424.4 - 430.7	Brown slightly shaly sandstone.
430.7 - 434.0	Gray shale.

Coring was started at a depth of 413.0 feet in laminated shaly sandstone and completed at 434.0 feet in gray shale. For the most part, the pay is made up of grayish light brown to brown slightly shaly 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 5.6 and 16.1 millidarcys respectively; the overall average being 13.4 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a somewhat irregular

permeability profile. The permeability of the sand varies from 0.28 to a maximum of 52 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 34.1. The weighted average percent oil saturation of the upper and lower sections is 24.4 and 37.2 respectively. The weighted average percent water saturation of the upper and lower sections is 64.8 and 44.8 respectively; the overall average being 50.0 (See Table III). This gives an overall weighted average total fluid saturation of 84.1 percent.

The weighted average oil content of the upper and lower sections is 295 and 507 barrels per acre foot respectively; the overall average being 451. The total oil content, as shown by this core, is 7,539 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 755 barrels of oil per acre was obtained from 6.4 feet of sand. The weighted average percent oil saturation was reduced from 46.9 to 38.6, or represents an average recovery of 8.3 percent. The weighted average effective permeability of the samples is 0.88 millidarcys, while the average initial fluid production pressure is 33.6 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 18 samples tested, 8 produced water and 7 oil. This indicates that approximately 39 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

Based on the results of the laboratory tests, it appears that efficient primary and secondary operations in the vicinity of this well should recover approximately 1,270 barrels of oil per acre. This is an average recovery of 198 barrels per acre foot from the 6.4 feet of floodable pay sand analyzed in this core.

The following data and assumptions were used in calculating the above recovery value:

Original formation volume factor	1.02
Reservoir water saturation, percent	32.0
Present oil saturation, percent	66.7
Average porosity, percent	18.2
Oil saturation after flooding, percent	38.6
Performance factor	0.50
Net floodable pay sand, feet	6.4

This core shows a slightly shaly pay sand section having a fairly good oil saturation, a moderate water saturation, and a wide variation in effective permeability.

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Synergy Oil Company Lease ZumMallen Well No. I-3

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			Ft.	Cum. Ft.		
1	413.6	14.7	10	76	114	7.2	1.0	1.0	114	7.20
2	414.6	13.1	18	73	183	0.88	0.9	1.9	165	0.79
3	415.4	16.9	28	67	366	4.4	1.0	2.9	366	4.40
4	416.7	12.8	29	62	288	9.3	0.8	3.7	230	7.44
5	417.7	18.1	43	38	603	6.8	0.7	4.4	422	4.76
6	418.5	20.1	42	33	654	13	1.0	5.4	654	13.00
7	419.4	17.5	23	51	312	0.28	1.0	6.4	312	0.28
8	420.5	11.1	14	77	121	9.4	1.1	7.5	133	10.34
9	421.5	17.6	44	36	600	9.6	0.7	8.2	420	6.72
10	422.5	18.3	48	30	681	40.5	0.7	8.9	477	28.00
11	423.5	13.1	27	67	278	2.5	1.5	10.4	417	3.75
12	424.5	16.3	37	51	467	3.9	0.6	11.0	280	2.34
13	425.4	17.5	55	31	746	33	1.0	12.0	746	33.00
14	426.5	19.2	50	29	744	20.6	1.0	13.0	744	20.00
15	427.5	18.6	32	51	461	2.6	1.0	14.0	461	2.60
16	428.5	16.3	46	33	581	52	1.0	15.0	581	52.00
17	429.5	17.5	43	31	583	23	1.0	16.0	583	23.00
18	430.5	20.0	40	42	620	4.9	0.7	16.7	434	3.43

Oilfield Research Laboratories

SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

I-3

Company Synergy Oil Company Lease ZumMallen Well No.

Depth Interval, Feet	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
413.0 - 418.2	413.0 - 418.2	4.4	5.6	24.59
418.2 - 430.7	418.2 - 430.7	12.3	16.1	198.46
413.0 - 430.7	413.0 - 430.7	16.7	13.4	223.05

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 Bbl./Acre
413.0 - 418.2	4.4	15.1	24.4	64.8	295	1,297
418.2 - 430.7	12.3	16.9	37.2	44.8	507	6,242
413.0 - 430.7	16.7	16.4	34.1	50.0	451	7,539

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

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			
1	413.6	14.5	12	135	0	0	12	86	0	Imp.	-
2	414.6	13.1	18	183	0	0	18	75	0	Imp.	-
3	415.4	17.2	26	346	0	0	26	69	6	0.34	40
4	416.7	13.2	29	296	0	0	29	69	0	Imp.	-
5	417.7	18.4	43	613	0	0	43	53	0	Imp.	-
6	418.5	20.0	42	651	8	124	34	60	2	0.01	50
7	419.5	17.6	23	314	0	0	23	57	0	Imp.	-
8	420.5	11.4	15	133	0	0	15	78	0	Imp.	-
9	421.5	17.8	44	607	10	138	34	60	4	0.20	45
10	422.5	18.0	48	670	13	182	35	62	31	0.80	20
11	423.5	13.4	26	270	0	0	26	69	0	Imp.	-
12	424.5	16.1	37	462	0	0	37	53	0	Imp.	-
13	425.4	17.9	55	763	13	181	42	55	29	0.80	30
14	426.5	19.5	50	755	8	121	42	55	25	0.80	30
15	427.5	18.4	34	485	0	0	34	60	0	Imp.	-
16	428.5	16.7	46	596	5	65	41	56	77	2.90	20
17	429.5	17.2	43	573	3	40	40	55	10	0.40	40
18	430.5	19.7	41	626	0	0	41	45	0	Imp.	-

Company Synergy Oil Company Lease ZumMallen Well No. I-3

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.

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Synergy Oil Company	Lease	ZumMallen	Well No.	I-3
Depth Interval, Feet	418.2 - 430.0				
Feet of Core Analyzed	6.4				
Average Percent Porosity	18.2				
Average Percent Original Oil Saturation	46.9				
Average Percent Oil Recovery	8.3				
Average Percent Residual Oil Saturation	38.6				
Average Percent Residual Water Saturation	57.3				
Average Percent Total Residual Fluid Saturation	95.9				
Average Original Oil Content, Bbls./A. Ft.	661.				
Average Oil Recovery, Bbls./A. Ft.	118.				
Average Residual Oil Content, Bbls./A. Ft.	543.				
Total Original Oil Content, Bbls./Acre	4,232.				
Total Oil Recovery, Bbls./Acre	755.				
Total Residual Oil Content, Bbls./Acre	3,477.				
Average Effective Permeability, Millidarcys	0.88				
Average Initial Fluid Production Pressure, p.s.i.	33.6				

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