Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

G-15

Company Kenny Keas, et al Lease Umbarger Well No. 3-A

Location 320' West of East line & 965' South of North line, SW

Section 36 Twp. 28S Rge. 16E County Wilson State Kansas

Name of Sand	Squirrel
Top of Core	654.0
Bottom of Core	684.0
Top of Sand	658.5
Bottom of Sand	677.5
Total Feet of Permeable Sand	16.1
Total Feet of Floodable Sand	8.1

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	5.0	5.0
5 - 10	2.8	7.8
10 - 50	5.0	12.8
50 - 78	3.3	16.1

Average Permeability Millidarcys	23.2
Average Percent Porosity	18.2
Average Percent Oil Saturation	52.9
Average Percent Water Saturation	21.2
Average Oil Content, Bbls./A. Ft.	754.
Total Oil Content, Bbls./Acre	12,130.
Average Percent Oil Recovery by Laboratory Flooding Tests	15.2
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	226.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,826.
Total Calculated Oil Recovery, Bbls./Acre	2,040.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water 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 non-virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
654.0 - 658.5	Sandy shale.
658.5 - 660.0	Brown and gray, laminated, shaly sandstone.
660.0 - 661.6	Sandy shale.
661.6 - 663.4	Brown calcareous sandstone.
663.4 - 664.3	Gray sandy limestone.
664.3 - 668.6	Brown, laminated, slightly shaly sandstone.
668.6 - 677.6	Brown and dark, laminated, shaly sandstone.
677.6 - 680.0	Laminated sandy shale.
680.0 - 684.0	Sandy shale.

Coring was started at a depth of 654.0 feet in sandy shale and completed at 684.0 feet also in sandy shale. For the most part, the pay is made up of brown, laminated, 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 22.4 and 25.0 millidarcys respectively; the overall average being 23.2 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has an irregular permeability profile. The permeability of the sand varies from 0.43 to a maximum of 78. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 52.9. The weighted average percent oil saturation of the upper and lower sections is 53.6 and 51.4 respectively. The weighted average percent water saturation of the upper and lower sections is 21.6 and 20.4 respectively; the overall average being 21.2 (See Table III). This gives an overall weighted average total fluid saturation of 74.1 percent. This low total fluid saturation indicates considerable fluid was lost during coring most of which was probably oil.

The weighted average oil content of the upper and lower sections is 799 and 654 barrels per acre foot respectively; the overall average being 754. The total oil content, as shown by this core, is 12,130 barrels per acre of which 6,359 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 1,826 barrels of oil per acre was obtained from 8.1 feet of sand. The weighted average percent oil saturation was reduced from 54.2 to 39.0, or represents an average recovery of 15.2 percent. The weighted average effective permeability of the samples is 0.811 millidarcys, while the average initial fluid production pressure is 34.4 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 17 samples tested, 12 produced water and 9 oil. This indicates that approximately 53 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 an efficient waterflood in the vicinity of this well should recover approximately 2,040 barrels of oil per acre or an average of 252 barrels per acre foot from the 8.1 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.05
Present formation volume factor	1.02
Reservoir water saturation, percent	15.0
Primary recovery, estimated, percent	8.0
Present oil saturation, percent	74.5
Average porosity, percent	18.7
Oil saturation after flooding, percent	39.0
Performance factor, percent	50.0
Net floodable pay sand, feet	8.1

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 Kenny Keas, et al Lease Umbarger Well No. 3-A

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	659.1	17.8	35	34	69	483	0.43	1.0	1.0	483	0.43
2	662.1	14.2	51	23	74	561	12.	1.0	2.0	561	12.00
3	663.1	14.1	55	16	71	601	8.3	0.8	2.8	481	6.64
4	664.4	18.4	49	13	62	699	78.	0.3	3.1	210	23.40
5	665.1	21.8	56	18	74	946	8.2	1.0	4.1	946	8.20
6	666.1	21.0	46	23	69	749	25.	1.0	5.1	749	25.00
7	667.1	15.6	57	23	80	689	4.2	1.0	6.1	689	4.20
8	668.1	20.5	57	20	77	906	70.	1.0	7.1	906	70.00
9	669.1	19.9	50	21	71	771	27.	1.0	8.1	771	27.00
10	670.1	24.4	65	28	93	1,231	1.7	1.0	9.1	1,231	1.70
11	671.1	18.9	54	17	71	790	62.	1.0	10.1	790	62.00
12	672.1	20.4	66	16	82	1,043	9.0	1.0	11.1	1,043	9.00
13	673.1	18.6	56	11	67	806	56.	1.0	12.1	806	56.00
14	674.1	16.9	66	14	80	863	33.	1.0	13.1	863	33.00
15	675.1	15.2	53	25	78	624	30.	1.0	14.1	624	30.00
16	676.1	16.2	47	23	70	589	4.9	1.0	15.1	589	4.90
17	677.1	14.3	35	29	64	388	0.89	1.0	16.1	388	0.89
								Total-------		12,130	

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Kenny Keas, et al Lease Umbarger Well No. 3-A

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
658.5 - 672.6	11.1	22.4	249.57
672.6 - 677.6	5.0	25.0	124.79
658.5 - 677.6	16.1	23.2	374.36

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
658.5 - 672.6	11.1	19.0	53.6	21.6	799	8,860
672.6 - 677.6	5.0	16.3	51.4	20.4	654	3,270
658.5 - 677.6	16.1	18.2	52.9	21.2	754	12,130

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Kenny Keas, et al Lease Umbarger Well No. 3-A

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	659.1	17.5	36	488	0	0	36	33	488	0	Imp.	-
2	662.1	14.7	51	581	16	182	35	50	399	13	0:300	40
3	663.1	14.0	55	596	7	76	48	35	520	7	0.200	50
4	664.4	18.0	49	683	14	195	35	52	488	48	1.00	20
5	665.1	21.3	56	924	21	347	35	52	577	10	0.300	50
6	666.1	20.7	46	739	12	193	34	53	546	11	0.300	40
7	667.1	15.2	58	684	0	0	58	25	684	0	Imp.	-
8	668.1	20.0	57	883	21	326	36	52	557	128	2.60	20
9	669.1	19.5	50	756	11	166	39	52	590	56	1.20	20
10	670.1	24.2	64	1202	0	0	64	30	1202	0	Imp.	-
11	671.1	20.0	66	1023	29	449	37	54	574	38	0.900	30
12	672.1	18.4	54	771	3	43	51	39	728	12	0.500	40
13	673.1	18.6	55	793	0	0	55	12	793	0	Imp.	-
14	674.1	17.1	66	876	0	0	66	13	876	0	Imp.	-
15	675.1	15.5	53	637	0	0	53	43	637	5	0.200	40
16	676.1	16.0	48	595	0	0	48	31	595	8	0.300	40
17	677.1	14.3	37	410	0	0	37	46	410	7	0.300	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 Kenny Keas, et al Lease Umbarger Well No. 3-A

Depth Interval, Feet	658.5 - 672.6
Feet of Core Analyzed	8.1
Average Percent Porosity	18.7
Average Percent Original Oil Saturation	54.2
Average Percent Oil Recovery	15.2
Average Percent Residual Oil Saturation	39.0
Average Percent Residual Water Saturation	48.9
Average Percent Total Residual Fluid Saturation	87.9
Average Original Oil Content, Bbls./A. Ft.	786.
Average Oil Recovery, Bbls./A. Ft.	226.
Average Residual Oil Content, Bbls./A. Ft.	560.
Total Original Oil Content, Bbls./Acre	6,359.
Total Oil Recovery, Bbls./Acre	1,826.
Total Residual Oil Content, Bbls./Acre	4,533.
Average Effective Permeability, Millidarcys	0.811
Average Initial Fluid Production Pressure, p.s.i.	34.4

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