12-18-06

OILFIELD RESEARCH LABORATORIES

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Verde Oil Company
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Gentlemen:

Enclosed is the report of polymer screening and feasibility tests conducted on rotary cores taken from your Larson Sr., B Lease, located in Allen County, Kansas and submitted to our laboratory on March 27 and April 2, 1992.

Results of this laboratory feasibility study leads us to conclude this is a favorable prospect for polymer augmented waterflooding. Details of the laboratory procedure and the basis for this conclusion are presented in the text of the report.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

G. Bob Barnett

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GBB:bl

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RESULTS OF POLYMER FEASIBILITY TESTING

Representative samples were carefully selected from Well Nos. 17-16 and 18-15 and then placed in the laboratory apparatus and flooded with lease crude oil to residual water saturation. The permeability of the samples to oil at residual water saturation was then determined.

Once completed, the samples were flooded with synthetic brine to residual oil saturation and the permeability to water at residual oil determined.

The samples were then flooded with polymer solutions. Dry polymer had been dissolved in water earlier and diluted to concentrations of 250, 500, 750 and 1000 parts per million. These batches were tested with the screen and Brookfield viscometers for proper quality. A curve of polymer solution viscosity vs concentration is attached as Table I. The laboratory procedure for polymer flooding is as follows:

1. The lower concentration of polymer solution is injected into the samples at a constant rate until equilibrium pressure is achieved. At this point, sufficient data is available to calculate a resistance factor. As an example, before any polymer was introduced into the sample taken at 836.3 feet from Well No. 17-16, it was determined that brine flowing

at 0.4 milliliters per minute at residual oil saturation reached an equilibrium pressure of 1.9 psi. The polymer solution of 250 ppm flowing at the same constant rate resulted in an equilibrium pressure of 10.8 psi. The resistance factor F_R is the ration of these equilibrium pressures or F_R = 10.8/1.9 = 5.7

2. Once the first polymer solution has been injected, the sample is flooded with brine to determine the residual resistance of the sample.

3. Steps 1 and 2 are repeated again for each concentration of polymer that has been prepared for test.

$$R_f(RAF) = \frac{(k_{rw}/\mu_w)\ \text{before polymerflow}}{(k_{rw}/\mu_w)\ \text{after polymerflow}}$$

DISCUSSION

A dry form of polyacrylamide polymer in the intermediate molecular weight range was used for these tests. This polymer was hydrated in synthetic injection water.

The synthetic brine used for these tests was prepared to the specifications indicated by our analysis of the injection water sample furnished by the client. The injection and produced water analyses are attached as Tables II and III.

Lease crude delivered to the laboratory was tested for gravity and viscosity at various temperatures. These results are enclosed as Table IV. No particular difficulty was encountered in filtering the oil through a 0.45 micron filter.

Resistance factors are an important criterion for the potential of polymer use in a project. The resistance factors acheived varied between 3.0 and 11.3. For details, please refer to Table V - "Results of Polymer Feasibility Tests".

Adsorption factors were determined during the injection of the first polymer solution into each sample plug. Adsorption of polymer onto the rock matrix of the samples tested ranged from 144 to 208 pounds of polymer per acre-foot of rock, with an average of 177. These adsorption values are in the range of normally economic polymer operations.

CONCLUSION

Test results indicate that favorable conditions for polymer flooding are present in the samples analyzed. An overall field reservoir study would be necessary to more quantitatively describe the estimated future production rates and economics in our judgement.

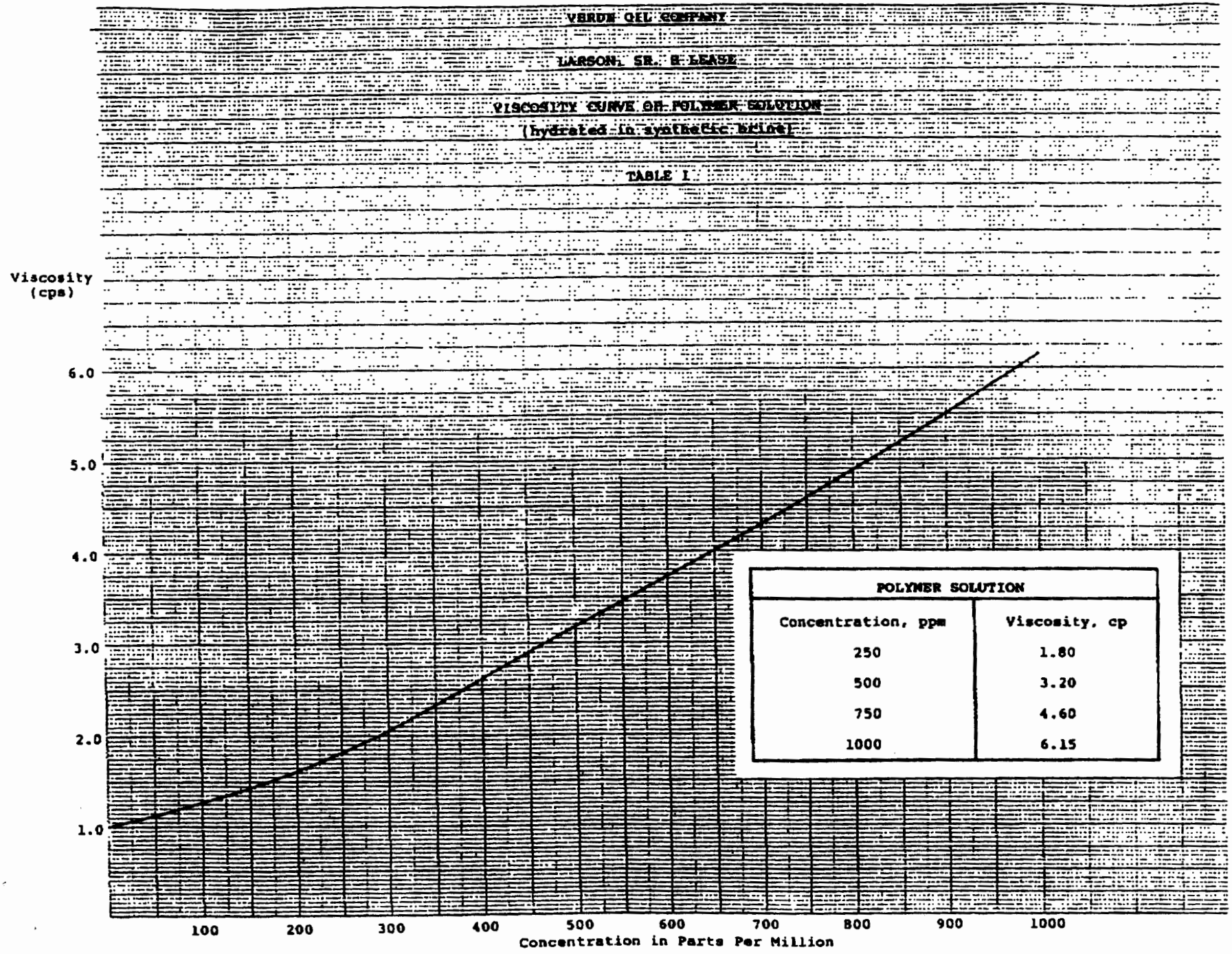
VERDE OIL COMPANY

LARSON, SR. B LEASE

VISCOSITY CURVE OF POLYMER SOLUTION

(hydrated in synthetic brine)

TABLE I



POLYMER SOLUTION	
Concentration, ppm	Viscosity, cp
250	1.80
500	3.20
750	4.60
1000	6.15

WATER ANALYSIS REPORT

TABLE II

Company Verde Oil Company Laboratory No. ____

Description of Sample Larson, Sr. B: injection water

Section 33 Twp. 26S Rge. 20E County Allen State Kansas

Date Sampled 6-23-92 Date Received 6-23-92 Analyst Dunning

Date Analyzed 6-23 & 24-92

RADICAL	MILLIGRAMS/LITER	MILLIGRAM, PERCENT
Sodium & Potassium	2,319.	35.06
Iron	0.05	-
Barium	5.0	0.08
Calcium	104.	1.57
Magnesium	53.	0.80
Chlorides	3,617.	54.67
Carbonates		
Bicarbonates	515.	7.79
Sulphates	2.0	0.03
TOTAL SOLIDS	6,615.	100.00

Carbonate Supersaturation ____

Specific Gravity @ 60° F. ____

pH 7.8

Temporary Hardness ____

Permanent Hardness ____

Total Hardness ____

Notes: All tests performed on filtered portion of sample.

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WATER ANALYSIS REPORT

TABLE III

Company Verde Oil Company Laboratory No. _____

Description of Sample Larson, Sr. B: produced water

Section 33 Twp. 26S Rge. 20E County Allen State Kansas

Date Sampled 6-23-92 Date Received 6-23-92 Analyst Dunning

Date Analyzed 6-23 & 24-92

RADICAL	MILLIGRAMS/LITER	MILLIGRAM, PERCENT
Sodium & Potassium	3,142.	34.58
Iron	1.3	0.01
Barium	54.	0.59
Calcium	132.	1.45
Magnesium	74.	0.81
Chlorides	4,823.	53.07
Carbonates		
Bicarbonates	861.	9.47
Sulphates	2.0	0.02
TOTAL SOLIDS	9,089.	100.00

Carbonate Supersaturation _____

Specific Gravity @ 60° F. _____

pH 7.45

Temporary Hardness _____

Permanent Hardness _____

Total Hardness _____

Notes: All tests performed on filtered portion of sample.

OILFIELD RESEARCH LABORATORIES
CORE ANALYSIS

GRAVITY AND VISCOSITY TESTS

OF LEASE CRUDE

TABLE IV

Company Verde Oil Company Laboratory No. ____

Description of Sample Larson, Sr. B, Well No. 19-14

Section 33 Twp. 26S Rge. 20E County Allen State Kansas

Date Sampled 6-23-92 Date Received 6-23-92 Analyst Dunning

Date Analyzed 6-29-92

Gravity (Corrected to 60° F.)	Viscosity, Centipoise
23.5	85.9 @ 76°F.
	50.2 @ 96°F.
	34.8 @ 116°F.

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CORE ANALYSIS

RESULTS OF POLYMER FEASIBILITY TESTS

TABLE V

COMPANY Verde Oil Company

LEASE Larson, Sr. B, Well Nos. 17-16 (836.3') & 18-15 (828.5' - 841.4')

SAND Tucker

OIL Lease Crude: Gravity 23.5

WATER Synthetic: 5,936 mg/l NaCl
104 mg/l Ca++
53 mg/l Mg++

Depth, Feet	Test Conditions: Plug Length cm	Water cp	Oil cp	Temp. °F.	Porosity Percent	Permeability, md: Air	Korw	Kwro	Mobility Ratio	Polymer Data: Conc. ppm	Res. Fac.: F_R	F_{RR}	Viscosities: S.F.	Brook	Adsorp. lb./A.Ft.
828.5	2.50	1.0	85.9	Room	22.2	809	424	91	18.5	250	3.0	1.7	6.94	1.80	144
										500	4.2	1.7	9.90	3.20	
										750	5.3	1.8	12.30	4.60	
										1000	6.6	1.8	13.93	6.15	
836.3	2.50	1.0	85.9	Room	20.4	208	112	25	19.5	250	5.7	1.9	6.94	1.80	208
										500	7.1	1.9	9.90	3.20	
										750	8.5	1.9	12.30	4.60	
										1000	10.0	1.9	13.93	6.15	
841.4	2.50	1.0	85.9	Room	22.0	527	371	64	14.7	250	5.9	2.4	6.94	1.80	179
										500	8.0	2.6	9.90	3.20	
										750	10.3	2.6	12.30	4.60	
										1000	11.3	2.2*	13.93	6.15	

*Good show of oil in effluent.

$$\frac{\frac{k_{rw}}{\mu_w}}{\frac{k_{ro}}{\mu_o}} = \left(\frac{k_{rw}}{k_{ro}}\right)\left(\frac{\mu_o}{\mu_w}\right)$$

$$= \left(\frac{91}{424}\right)\left(\frac{1.7}{1}\right)$$

$$= 25$$