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New Acid Stimulation Treatment to Sustain Production – Los Angeles Downtown Oil Field

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Abstract

- New Acid Stimulation Treatment to Sustain Production, Los Angeles Downtown Oil Field
- Hydrochloric acid stimulation has been successfully used on several wells in the Los Angeles Downtown Field, in the past. However, the decline rates after stimulation have been relatively high and generally within six months to a year, production rates have returned to their pre-stimulation rates. The wells in Los Angeles Downtown Field have strong scale producing tendencies and many wells are treated for scale control. Four wells have been carefully selected that are representative of wells that have a tendency to form calcium carbonate scale and have shown substantial decline over the last few years.

Abstract, cont.

- The program design includes a chemically modified hydrochloric acid that has been implemented with phosphonic acid. The phosphonic acid reacts with aluminum in clays and feldspars to form a temporary protective film which allows deeper penetration and more effective reaction from the hydrochloric acid. Another side benefit of phosphonic acid is it's ability to inhibit the formulation of calcium carbonate scale.

Introduction

- DOE offered program early 1999
- Program for small oil producers
- Grant up to $75,000
- DOE provides up to half the cost of project experimentation with innovative methods & technology to improve profitability
- First selection of candidates June 25, 1999
- St. James project one of three selected from California. Name of St. James Project – Improved Acid Stimulation System Designed to Minimize Recline Rate – Los Angeles Downtown Field.

Introduction, cont.

- Hydrochloric acid stimulation has been used on several wells in L.A. Downtown Field in the past
- However, decline rate has been relatively high
- The wells in the L.A. Downtown Field have strong scale producing tendencies
- Many wells treated for scale control
- Four wells have been carefully selected that have strong tendency to form calcium carbonate scale
- Wells have also shown strong decline in the past few years
- Although it is to early to determine decline rate, initial results are encouraging

History

- Los Angeles Downtown Field is located one mile south of the Civic Center in downtown Los Angeles
- Field discovered in July 1964 by Chevron
- Thirty wells drilled
- Major field development completed August 1967
- Field has produced approximately 20 million barrels of oil and 24 million mcf of gas

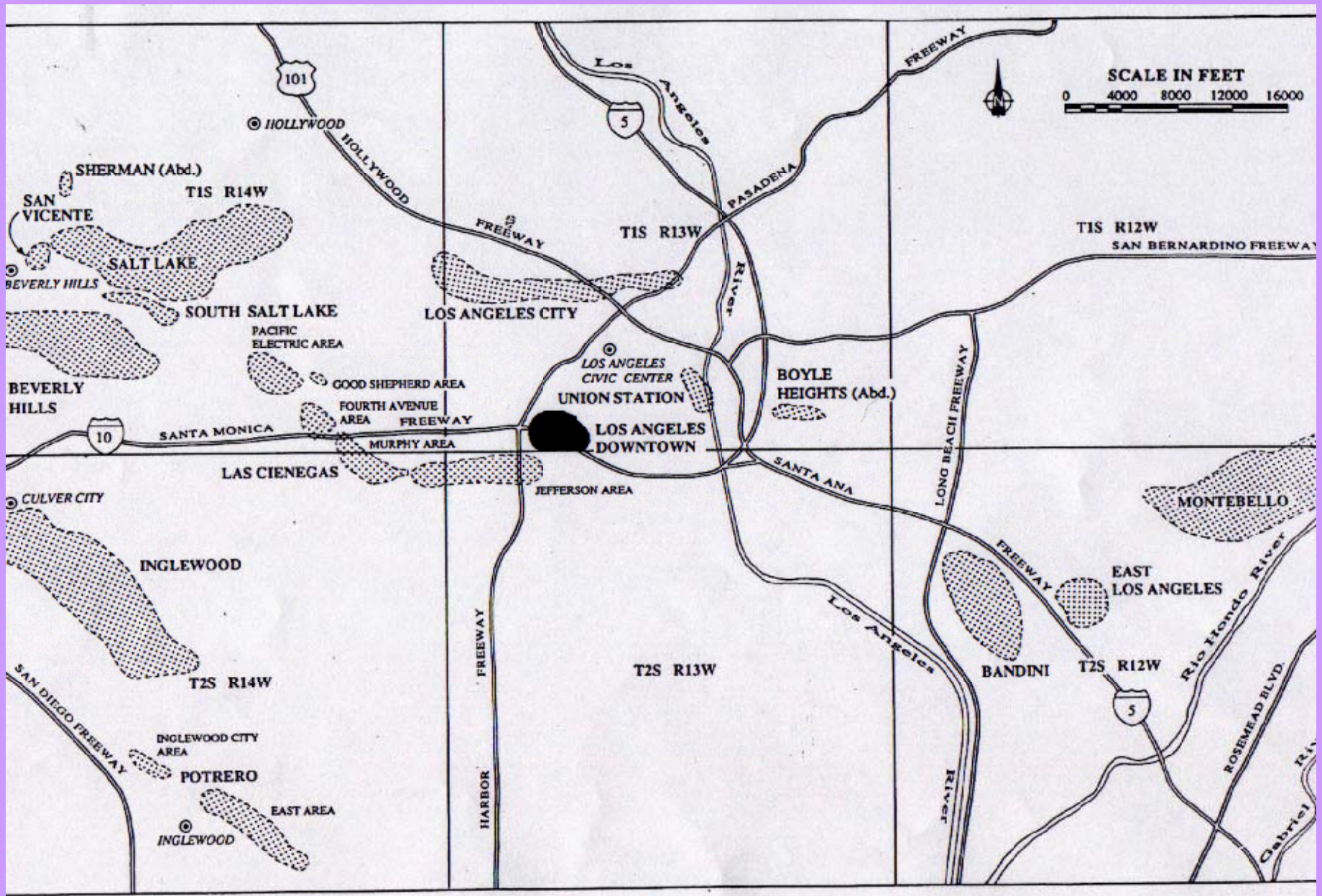
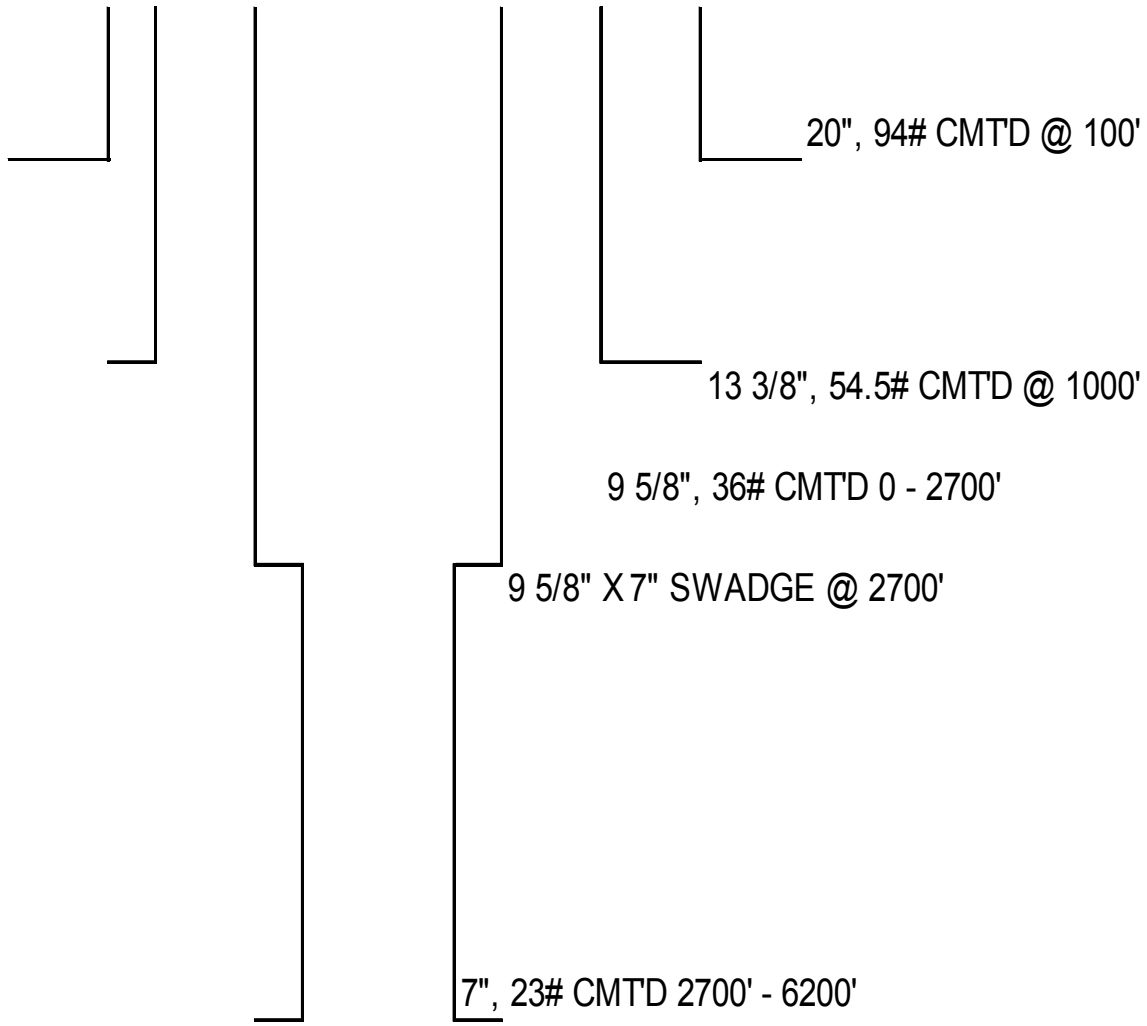


Figure 1. Location map, Los Angeles Downtown oil field.

TYPICAL WELLBORE SCHEMATIC



PERFORATIONS

SELECTIVELY PERFORATED
FROM 3600' TO 5600'
WITH 4 - 1/2" JHPF

Geology

- The field is on east-west trending anticlinal structure
- Upper Miocene – Puente Formation
- Hydrocarbons trapped in the area by faulted anticlinal closures
- Reservoir section consist of turbidite sands in three distinct zones
- Hill, Broadway and Massive
- The current acid stimulation program concentrated on the Broadway zone
- Broadway zone is composed of thinly interbedded sands and shales
- Oil production is from an area of 250 acres
- Wells range in depth from 1800 feet to 4900 feet vertical sub area

Reservoir Properties – Broadway Zone

- Depth Upper 2900’ – Middle 3100’ – Lower 3500’
- Porosity (%) 30
- Permeability (millidaries) 179
- Initial reservoir pressure (psi) 1590
- Initial reservoir temperature (F) 140
- Oil Gravity (api) 38
- Solution GOR (scf/stb) 1578
- Gas Heating Value (btu/cu.ft.) 1340
- Water Salinity, Nacl (ppm) 23,450

Program Selected

- First Stage:
- 15 gallons of 10% hydrochloric acid per foot of perforated interval
- Interval to be washed 300 feet
- Volume of hydrochloric acid 4500 gallons
- Second Stage:
- 4500 gallons of lease water plus 68 gallons of phosphonic acid
- Phosphonic acid reacts with aluminum in clays and feldspars to form a temporary protective film, thus allowing deeper and more effective reaction from the hydrochloric acid.

Selection of Treating Fluids

- While sandstone formations in the Downtown Field are relatively competent
- Best results in the past have been obtained using minimum volumes of low strength hydrochloric acid for scale removal and perforation clean out.
- Another side benefit of phosphonic acid is the ability to inhibit the formulation of calcium carbonate scale
- Many scale treatment programs, such as scale inhibition squeeze programs have demonstrated the effectiveness of the phosphonic acid in the treatment of calcium carbonate scale

Stimulation Procedure

- Carefully conduct well tests prior to well stimulation
- Move in Baker Type Tank or available storage facility to evaluate the fluids from the stimulated well
- Pull pump and tubing. (tbg tested – 5000 psi)
- Run casing scraper,
- a. To locate any casing restrictions

  b. To locate top of fill

  c. Clean out fill (if fill is above proposed wash zone)

  d. Clean casing wall (minimize leakage of wash tool)

Stimulation Procedure, cont.

- 1st STAGE
- Run circulation wash tool and stimulate per the following procedure using selected wash intervals.
- Use 4500 gallons 10% HCL Acid (15 gallons/foot) Note: maximum surface pressure 2000 psi and 2 BPM injection rate, circulate wash from bottom up.
- 2nd STAGE
- Run circulation wash tool and stimulate selected wash intervals with 4500 gallons of filtered lease water (15 gallons/foot) plus 68 gallons of phosphonic acid (HV) - scale inhibitor
- Pull circulating wash tool above liner top and secure well for the night.

Stimulation Procedure, cont.

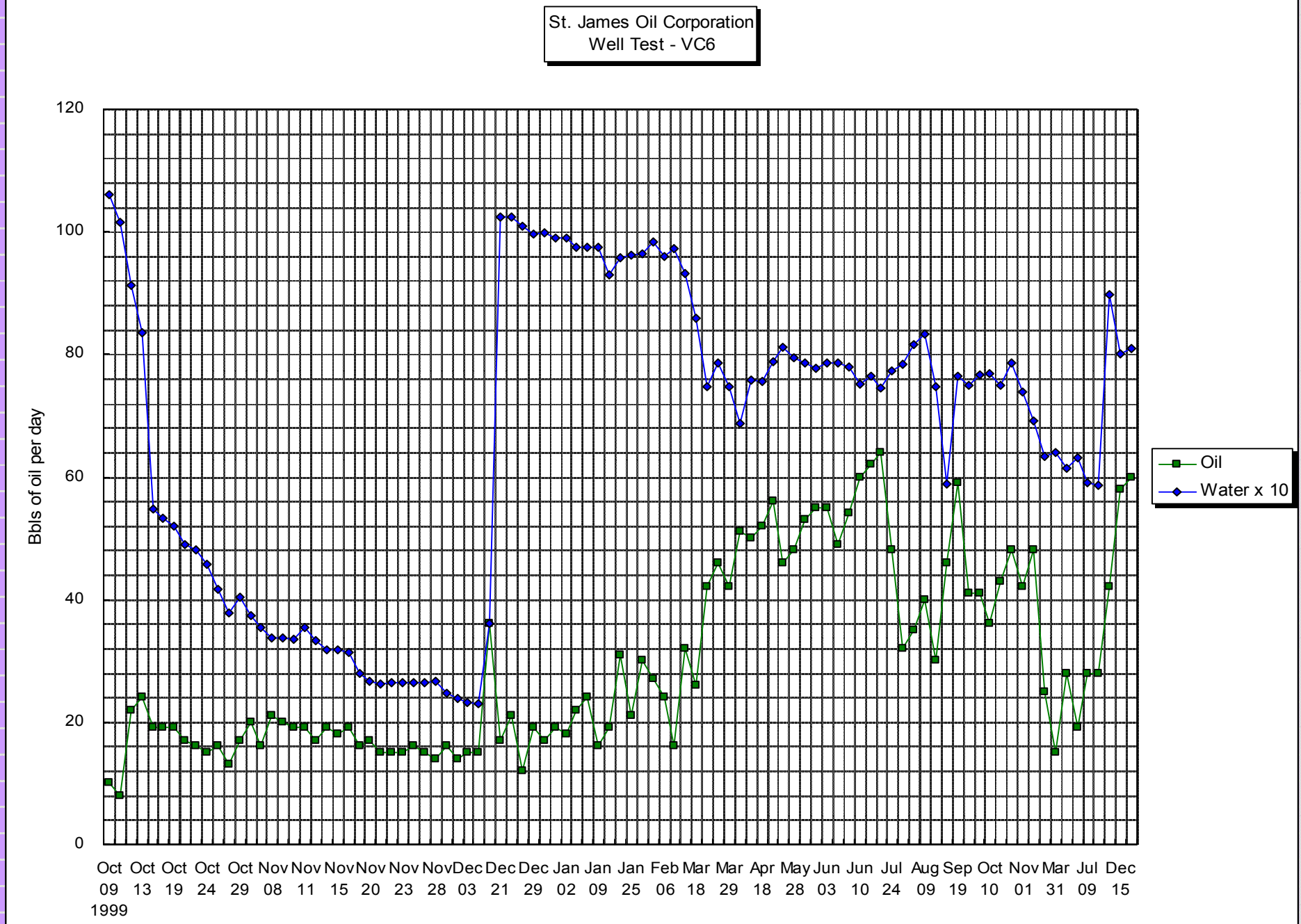
- Pull out of hole with wash tool
- Run pump assembly
- Place well on production into Baker Tank. Evaluate produced fluids for unspent acid. Obtain PH readings daily
- Note: Secure samples of the inhibited acid before and after performing the job.

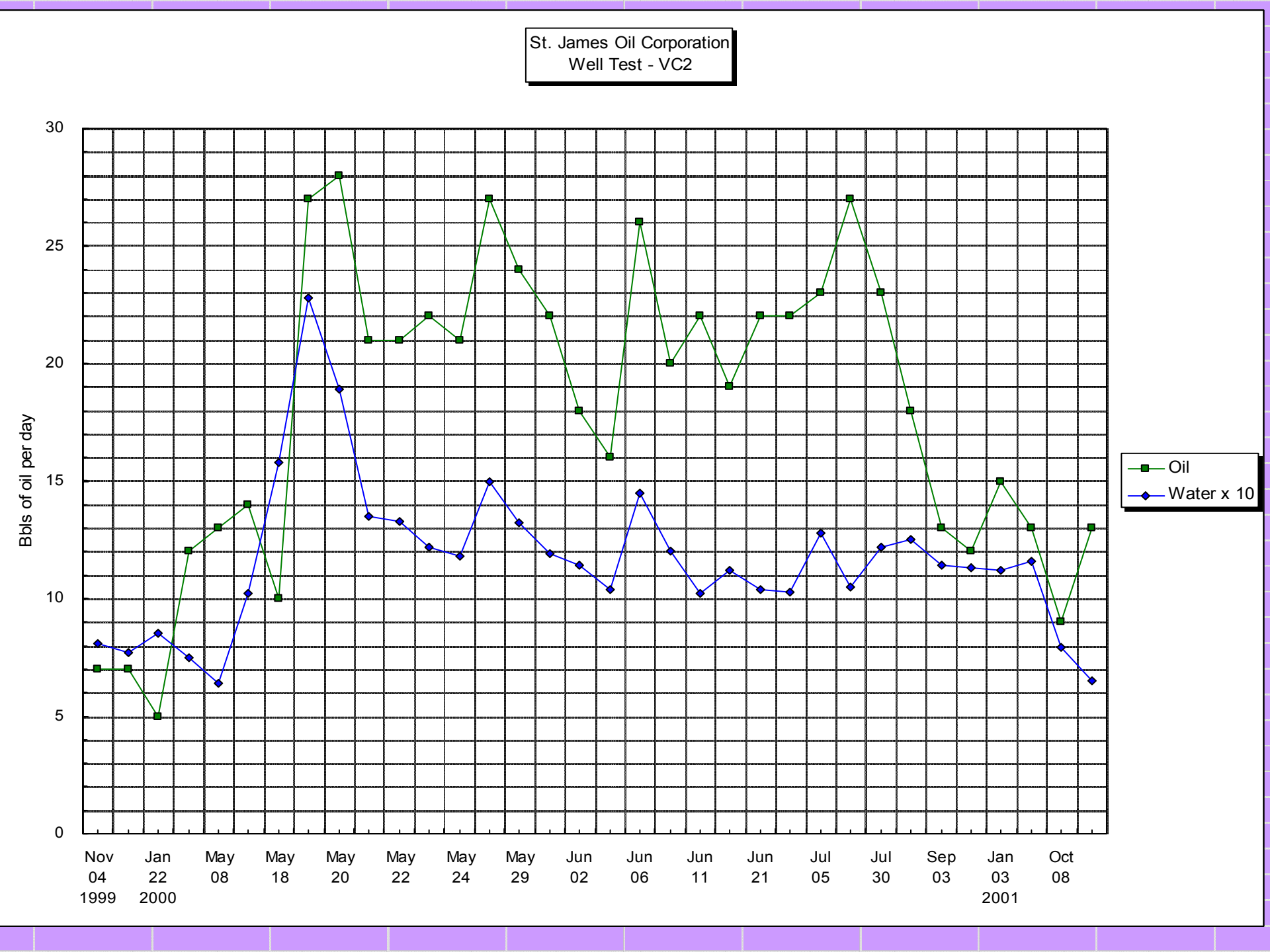
Stimulation Procedure, cont.

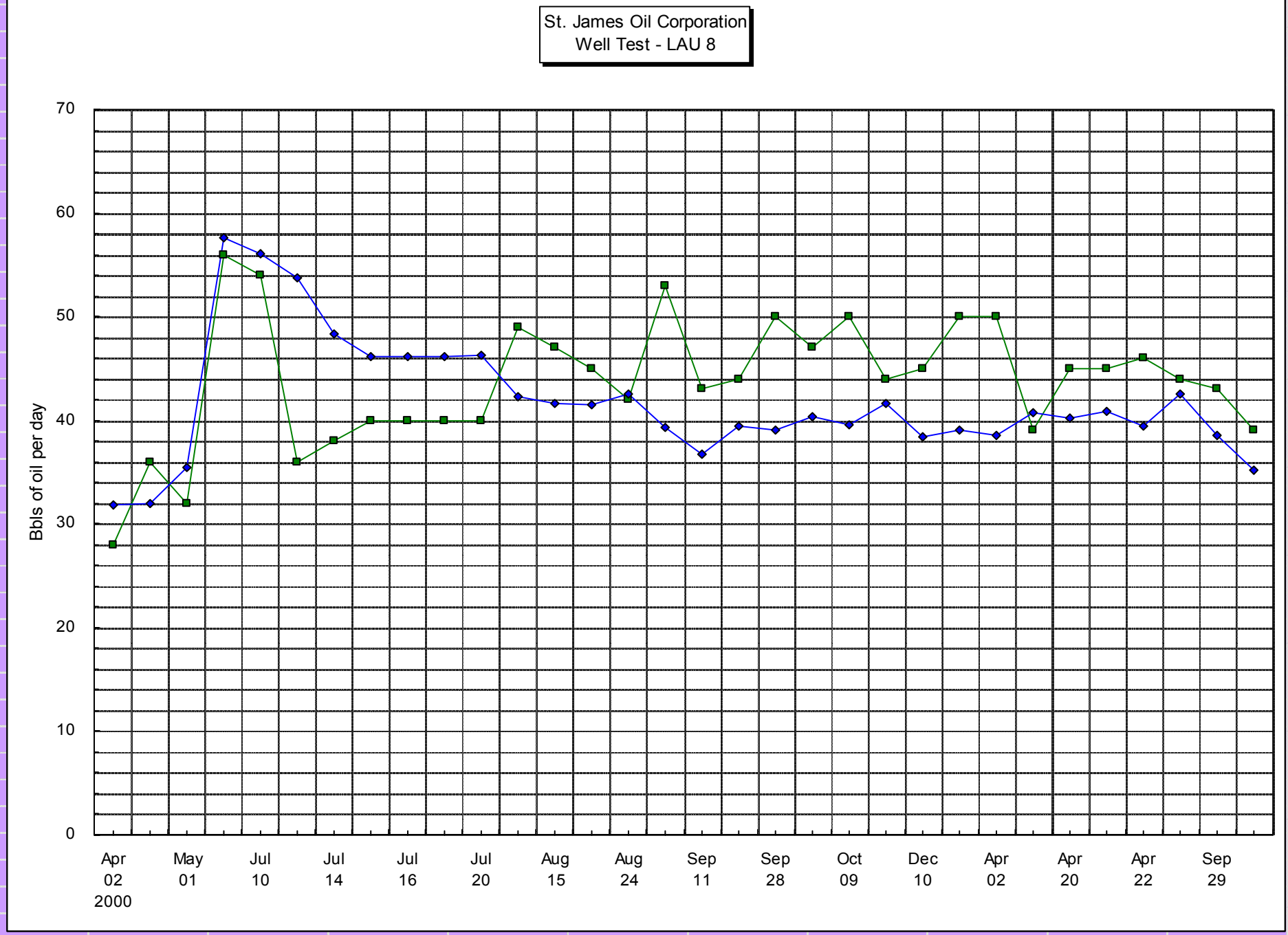
- The following protective additives were added to the acid stimulation chemicals to protect against corrosion, emulsion and sludge.
- a. 0.2% CL-25 (corrosion inhibitor)
- b. 0.2% NE 940 (now-emulsifier/wetting agent)
- c. 0.6% Ferrotrol 300L (iron control)
- d. 0.8% Ferrotrol 270L (iron reducing agent)
- e. 0.2% Ferrotrol 271L (iron reducing agent catalyst)
- f. 1.2% AS-6 (anti-sludge agent)
- February 1, 2000 corrosion, sludge and emulsion testing were performed on oil samples, including complete water analysis of lease water. Results of the tests indicated that by using the above listed agents no sludge or emulsion was detected after 2 hrs @ 130 degrees F. Corrosion loss was also found to be in favorable limits.

Conclusions

- Wells in the Los Angeles Downtown field can be successfully acid stimulated with the new hydrochloric-hydrophonic acid system.
- A time-rate evaluation of the current acid stimulation treatments indicates a significant improvement in response life when compared with past stimulation treatments. This improvement has been accomplished by using a modified hydrochloric-hydrophonic acid program that is designed to minimize the accumulation of scale and other formation damaging materials over an extended period of time.
- Recovery of well samples after acid stimulation can be a key to design improvement. Under dynamic conditions, laboratory evaluation of post stimulation samples can give you significantly better information and results than experienced in pre-stimulation tests.


St. James Oil Corporation
Well Test - VC6
Bbls of oil per day
120
100
80
60
40
20
0
Oct 09 1999
Oct 13
Oct 19
Oct 24
Oct 29
Nov 08
Nov 11
Nov 15
Nov 20
Nov 23
Nov 28
Dec 03
Dec 21
Dec 29
Jan 02
Jan 09
Jan 25
Feb 06
Mar 18
Mar 29
Apr 18
May 28
Jun 03
Jun 10
Jul 24
Aug 09
Sep 19
Oct 10
Nov 01
Mar 31
Jul 09
Dec 15
Oil
Water x 10


St. James Oil Corporation
Well Test - VC2
Bbls of oil per day
0
5
10
15
20
25
30
Nov 04 1999
Jan 22 2000
May 08
May 18
May 20
May 22
May 24
May 29
Jun 02
Jun 06
Jun 11
Jun 21
Jul 05
Jul 30
Sep 03
Jan 03 2001
Oct 08
Oil
Water x 10


St. James Oil Corporation
Well Test - LAU 8
Bbls of oil per day
70
60
50
40
30
20
10
0
Apr 02 2000
May 01
Jul 10
Jul 14
Jul 16
Jul 20
Aug 15
Aug 24
Sep 11
Sep 28
Oct 09
Dec 10
Apr 02
Apr 20
Apr 22
Sep 29

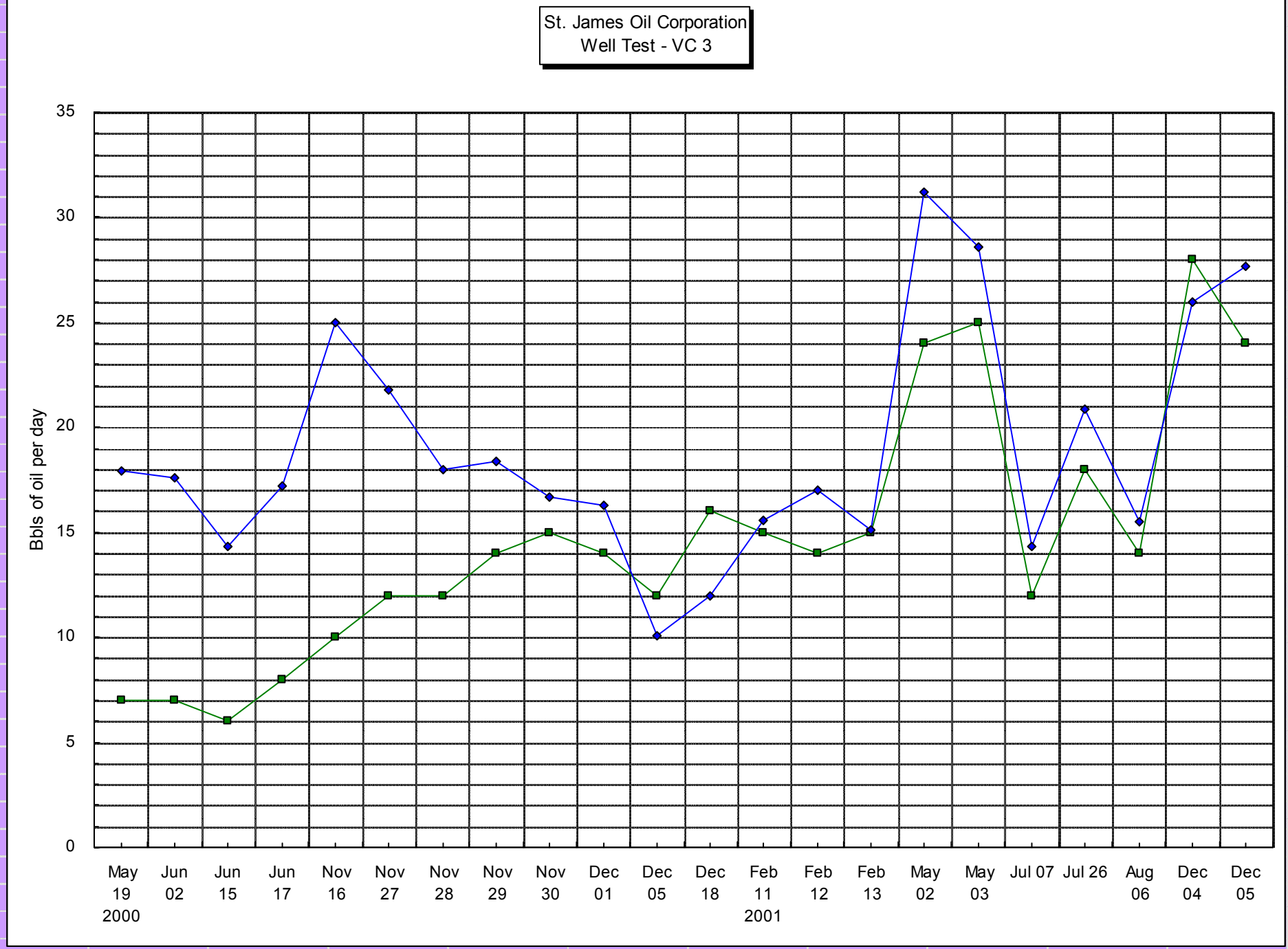

St. James Oil Corporation
Well Test - VC 3
Bbls of oil per day
0
5
10
15
20
25
30
35
May 19 2000
Jun 02
Jun 15
Jun 17
Nov 16
Nov 27
Nov 28
Nov 29
Nov 30
Dec 01
Dec 05
Dec 18
Feb 11 2001
Feb 12
Feb 13
May 02
May 03
Jul 07
Jul 26
Aug 06
Dec 04
Dec 05

Table 1

Oil Rate Response to Stimulation Treatment

Well No.	Date Treated	Prior to Treatment BOPD	Month Since Treatment	Average* Oil Rate Since Treatment	Average Increase in Oil Since Treatment
VC6	10-03-99	10	27	29	19
VC2	05-10-00	7	19	19	12
LA8	06-30-00	32	17	45	13
VC3	10-30-00	8	14	16	8
*Average Oil Rate as of 12-30-01	Total	57		109	52