PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Petroleum Exploration and Production

03/2005

ACID STIMULATION TO RESTORE SHUT-IN OIL FIELDS

PARTNERS

St. James Oil Corporation
Laguna Hills, CA

MAIN SITE

Las Cienegas field
Los Angeles, CA

Background

Low oil prices in 1998-1999 led to thousands of oil wells being shut in throughout the U.S. With a growing consensus that oil prices will remain elevated, returning shut-in wells to production is now an attractive economic option for the independent oil operator.

One such operator is St. James Oil Corp., Laguna Hills, CA, which was forced to shut in wells on its lease in Las Cienegas oil field in Los Angeles, CA, in 1999 amid low oil prices and high operating costs. Complicating matters for St. James is the urban setting for its lease, located about 2 miles from the Los Angeles Civic Center, in a region known for its stringent permitting and regulatory regime. St. James previously had encountered challenges in restoring shut-in Las Cienegas wells to production. The field's wells, when shut in for a long time and then returned to production, often produced at rates 30-50% less than their pre-shut-in rates. The major production impediment was migration of fines, coupled with clay dispersion and swelling. In addition, these wells experienced rapid scale build-up caused by invasion of filtrate, which resulted in a severe production decline.

The principal goal of the project is to restore production to wells in Las Cienegas field. Because Las Cienegas field is representative of many other California sandstone reservoirs, lessons learned in this project could help other operators in the state return to profitable operation oil and gas wells that have been shut in for a long time.

Project Description/Accomplishments

Five Las Cienegas wells, all of which have a high tendency to form calcium carbonate scale, were carefully selected for treating. These wells had been shut in for about 4 years. The objective of this project was to stimulate the wells and attempt to restore pre-shut-in oil production rates.

Laboratory and field tests indicated that, for this field and surrounding fields, mud acid systems can cause a matrix breakdown and further wellbore damage. Most treatments using a mud acid in Las Cienegas field have an average life of less than 6 months.

The program design includes the use of a chemically modified hydrochloric acid combined with phosphoric acid. The phosphoric acid in this formulation apparently reacts with aluminum in clays and feldspars to form a temporary protective film, which then allows a deeper penetration and more effective treatment. An important side

benefit of the phosphoric acid is its ability to inhibit the formation of calcium carbonate scale in the well and near-wellbore area.

Work on the five wells was expected to be completed within one year of the project start. But the project was delayed by metering, sampling, and pipeline construction required by Southern California Gas and the lack of a workover rig.

As of March 2005, all five of the test wells had been restored to production and initial production rates established. Four of the wells were acid-stimulated, and the fifth was slated for stimulation in March.

Initial tests demonstrated that hydrochloric acid modified with phosphoric acid can be used to successfully stimulate the wells and increase oil and gas production.

St. James also was granted a Pump III project, in cooperation with the Interstate Oil and Gas Compact Commission, California Oil Producers' Electricity Cooperative, California Energy Commission, and South Coast Air Quality Management District. This project resulted in installation of three microturbines to provide power to Las Cienegas field wells being returned to production.

Benefits/Impacts

The Las Cienegas well stimulation program has proven very effective in dissolving many types of scale. The phosphoric acid reacts with aluminum in clay and feldspars to form a temporary protective film, which then allows a deeper penetration and more effective treatment than with the hydrochloric acid alone. Phosphoric acid treatment also has the ability to inhibit formation of calcium carbonate scale in the well and near-wellbore area. Use of phosphoric acid stimulation will restore production in shut-in wells and prevent wellbore damage by carbonate scale.

The procedure has potential for a broad range of application, particularly in California, where thousands of wells were shut in in the late 1990s and early 2000s in areas where significant volumes of recoverable oil remain. Such new stimulation techniques can be used to restore production and prevent the premature abandonment of thousands of wells.

St. James Oil Corp.'s oil production flowlines at its Las Cienegas field lease in California.

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PROJECT DATA

DE-FG26-03NT15432
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Total Project Value
$205,000

DOE/Non-DOE Share
$100,000/$105,000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov