Exploitation and Optimization of Reservoir Performance in Hunton Formation, Oklahoma

DE-FC26-00NT15125

Project Goal

The Hunton formation in Oklahoma has some unique production characteristics, including large water production, initially decreasing gas-oil ratios, and excellent dynamic continuity—but poor geological continuity. The overall goal of the project is to understand the mechanism of gas and oil production from the Hunton Formation in Oklahoma so that similar reservoirs in other areas can be efficiently exploited. An additional goal is to develop methodologies to improve oil recovery using secondary recovery techniques.

Performers

University of Tulsa, Tulsa, OK
Marjo Operating Company, Tulsa, OK
University of Houston, Houston, TX
Orca Exploration, Tulsa, OK

Results

A reservoir model was developed to explain the principal mechanisms by which oil and gas are produced. The model consists of a fractured reservoir with good communication where most of the mobile water resides in high-permeability regions and oil resides in the low-permeability regions. As the water from high-permeability regions is depleted, first solution gas and then oil moves into the high-permeability region and eventually reaches the production well. The productivity of wells and percentage of oil and gas produced from a well are strongly dependent on hydrocarbon saturation and initial potential of the well and are not dependent on the hydrocarbons in the near-well region.

Experimental work confirmed the utility of using surfactants to recover additional oil through alteration of wettability.

Benefits

A methodology was developed to optimally exploit reservoirs that contain significant quantities of water. Log signatures can be used to determine the feasibility of the process and the ultimate recovery from these reservoirs. The best way to drill the wells and maintain productivity has been established. The new material-balance techniques developed can be applied to other, similar reservoirs. New methods are proposed to recover additional hydrocarbons through secondary mechanisms. Optimum well density is established and verified through the analysis of production data.

Background

The Hunton formation in Oklahoma has generated a lot of interest in the last decade due to early success in the 1990s in producing this unique formation. The wells produce large quantities of water before beginning production of hydrocarbons. Some wells never produce oil but produce gas. A very poor correlation exists between the volume of hydrocarbons in place and recoverable hydrocarbons. The reservoir exhibits significant dynamic continuity, as evidenced by interference between wells.

This study focused on determining the principal production mechanism for the Hunton, the optimal well density, and the important characteristics of successful wells. The study also addressed whether the success of West Carney field can be extended to other fields and whether there are other secondary mechanisms that will increase production.

Summary

This project investigated the procedure for optimizing production from gas reservoirs influenced by water influx. Based on the evaluation of logs, production, cores, and other geological information, the following conclusions can be drawn:

Regions with high porosity and high standard deviation of porosity tend to have low remaining oil-in-place, which results in low recovery factors for oil and gas.

The Index of Productivity of a well is very important in increasing the recoverable reserves.

For optimum recovery, four to five wells need to be drilled in an area of 640 acres.

Well type is not important, and even vertical wells perform as well as horizontal wells so long as the vertical wells have high productivity.

Using limited well log data, it is possible to assess the feasibility of viable gas production from as yet undeveloped fields.

A modified material balance technique was developed to investigate the effect of changing pressure on recovery. The technique indicates that lowering the reservoir pressure is much more beneficial to these reservoirs than it is in conventional gas reservoirs.

Use of surfactants may allow recovery of additional oil by changing the wettability of the rock.

Current Status (July 2007)

The project period ended in June 30, 2007. They are currently writing the final report for the project summarizing all the accomplishments and conclusions. The last part of the objective relates to developing an alternate procedure for improving the production rate. This requires drilling an additional 2000 ft to Viola formation and disposing off water directly into that formation instead of lifting it to the surface. They have finished the preliminary analysis and intend to report the economic evaluation in the final report.

Funding

This project was selected in response to DOE's Oil Exploration and Production solicitation DE-PS26-99BC15144 (May 1999), Reservoir Class Field Demonstration Program—Class Revisit.

Project Start: March 7, 2000
Project End: June 30, 2007

Anticipated DOE Contribution: $2,983,098
Performer Contribution: $9,393,634 (76 percent of total)

Contact Information

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Publications

Gupta, M., Joshi, R., and Kelkar, M., Dewatering of Hunton Reservoir: What Makes it Work? SPE 94347, SPE Production and Operations Symposium, Oklahoma City, OK, April 17-19, 2005.

Frederick, J., Kelkar, M., and Keefer, B., Production Type Curves for Hunton Formation, SPE 75248, SPE/DOE 13th Symposium on Improved Oil Recovery, Tulsa, OK, April 13-17, 2002.

Marwah, V., Kelkar, M., and Keefer, B., Reservoir Mechanism for Hunton Formation Production, SPE 75127, SPE/DOE 13th Symposium on Improved Oil Recovery, Tulsa, OK, April 13-17, 2002.

Joshi, R., and Kelkar, M., Production Performance Study of West Carney Field, Lincoln County, Oklahoma, SPE 89461, SPE/DOE 14th Symposium on Improved Oil Recovery, Tulsa, OK, April 17-21, 2004.

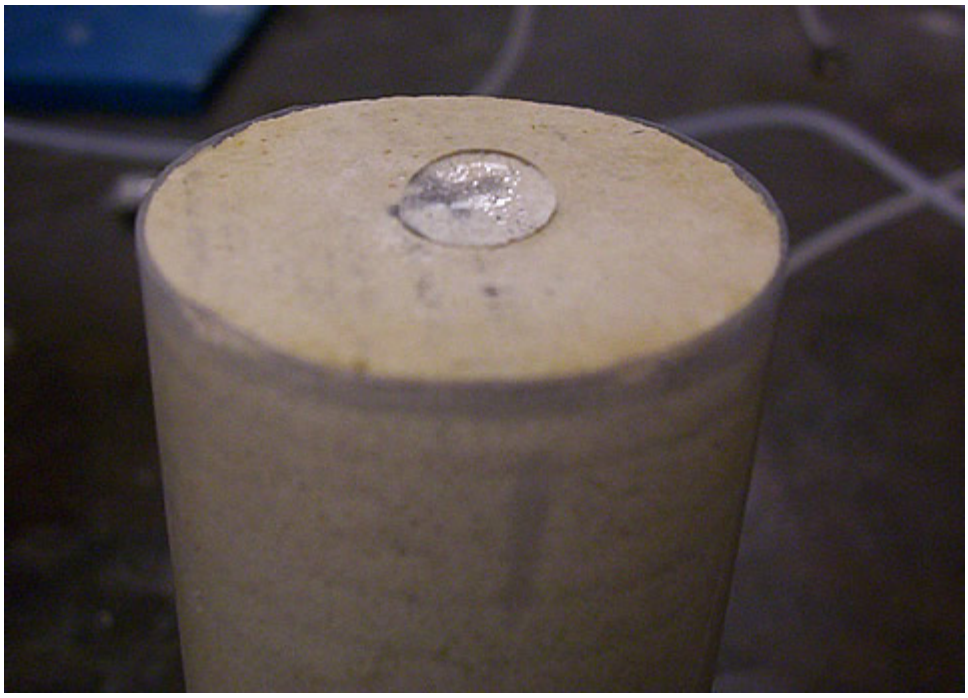
Zubarev, D., Patwardhan, S., Kelkar, M., and Keefer, B., Dewatering in Hunton Reservoir—Drill Vertical or Horizontal Well?, SPE 89462, SPE/DOE 14th Symposium on Improved Oil Recovery, Tulsa, OK, April 17-14, 2004.

Frederick, J. and Kelkar, M., Decline Curve Analysis for Solution Gas Drives, SPE 94859, SPE Annual Technical Conference and Exhibition, Dallas, TX, October 912, 2005.

Derby, James R., Podpechan, F. Joe, Andrews, Jason, and Ramakrishna, Sandeep, Development Case Study of a Karsted Carbonate 'Island' Hydrocarbon Reservoir: West Carney Hunton Field, Oklahoma, American Association of Petroleum Geologists, Search and Discovery online article No. 20008, 2002.

Podpechan, F. J., Derby, J.R., Andrews, J., and Ramakrishna, S., Dewatering as a Production Technique in a Dual Permeability Reservoir: West Carney Hunton Field, Lincoln and Logan Counties, Oklahoma, Mid-Continent Section Meeting.

PI presented a talk: " Dewatering of Hunton Reservoirs" in the Tulsa Association of Petroleum Landman meeting on April 19, 2007. Many local companies showed interests in de-watering projects.



Photograph of a core after treatment with surfactant F, indicating change in wettability of the surface. The drop of brine does not imbibe spontaneously into the carbonate rock.