Petroleum Technology Transfer Council

APPALACHIAN BASIN

Petroleum Technology Advances Through Applied Research by Independent Oil Producers - *Extract for the Appalachian Region*

April 1998

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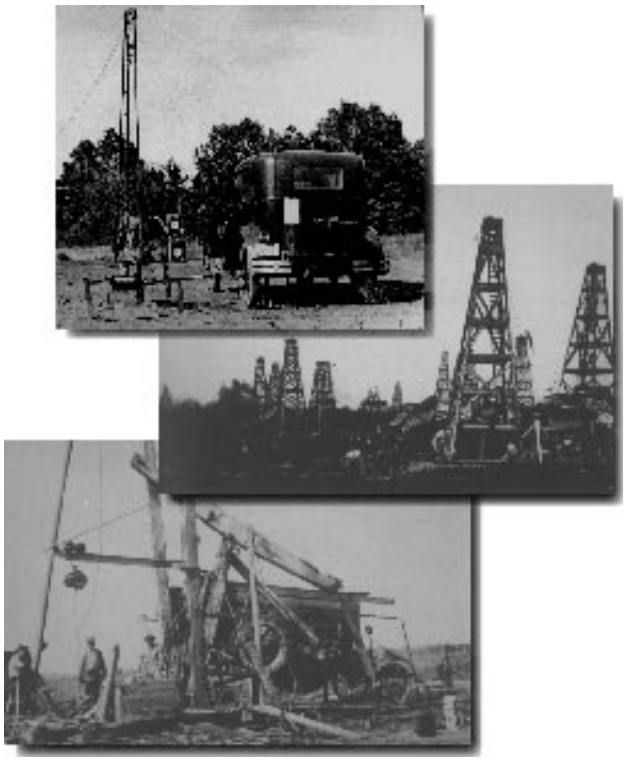
U. S. Department of Energy,
National Petroleum Technology Office,
Tulsa, Oklahoma

This PDF document represents a portion of a report released in April, 1998 by the U. S. Department of Energy, National Petroleum Technology Office (NPTO). For the convenience of constituents in Appalachian Region, five project reports directly relevant to the Appalachian basin have been extracted and reassembled into a smaller document by PTTC - Appalachian Region. The original report can be viewed in its entirety at http://www.npto.doe.gov/INDEP.PDF.



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Petroleum Technology Advances Through Applied Research by *Independent Oil Producers*

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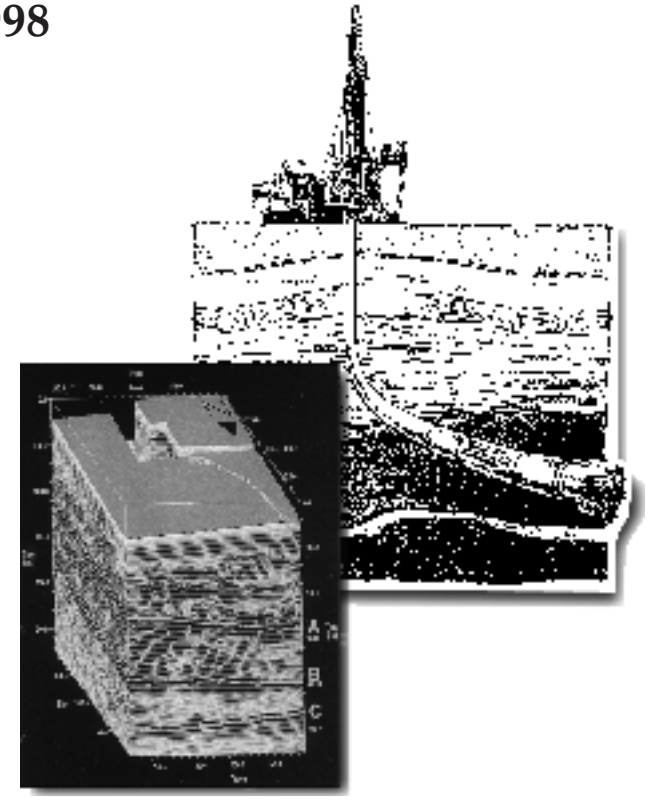

Implemented by
BDM-Oklahoma, Inc.
National Institute for Petroleum
and Energy Research
Bartlesville, Oklahoma

PETROLEUM TECHNOLOGY ADVANCES THROUGH APPLIED RESEARCH BY INDEPENDENT OIL PRODUCERS

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BDM-Oklahoma, Inc.
P.O. Box 2565
Bartlesville, Oklahoma 74005

Support to Independents

Petroleum Technology Advances Through Applied Research by Independent Oil Producers

Introduction

The United States Department of Energy, through the National Petroleum Technology Office (DOE/NPTO), is targeting technical assistance through "Research and Development by Small Independent Petroleum Operators" (Support to Independents) to provide solutions for local production problems. Small independents are defined as those having less than 50 employees. Many small independents lack resources to test unfamiliar technologies or novel, unproven approaches without cost-sharing to reduce financial risk. By providing cost-sharing ($50,000 or less per project), DOE/NPTO is encouraging producers to experiment with higher risk approaches that could mean the difference between maintaining production or shutting down an oil field.

The goals and objectives for this program are listed as follows:

1. Extend the economic production of domestic fields by slowing the rate of well abandonments and preserving industry infrastructure (including facilities, wells, data, and expertise).
2. Increase ultimate recovery in known fields using advanced technologies by demonstrating:
   - Better methods for formation evaluation
   - Developmental oil recovery and production technologies
   - Well control and remedial work for environmental compliance
3. Use field demonstrations to broaden information exchange and technology application among stakeholders by:
   - Expanding participation in DOE projects to include both traditional and non-traditional participants
   - Increasing third-party participation and interaction throughout the life of DOE-sponsored projects
   - Making technology transfer products user-friendly

Since the initial program announcement in February 1995, 22 projects have been awarded. About one in five proposals has received an award. Table 1 summarizes the name of the company, project location, technology area, and specific technical activity employed for each project. Individual fact sheets in the tabbed sections contain specific project information and the results reported to date.

Table 1 Technology Development Contracts

Company	State	Technology	Technical Activity
Cleary Exploration	OK	Drilling	Horizontal Drilling
EDCO Oil Company	OH	Drilling	Horizontal Drilling
Brothers Production	TX	Exploration	3-D Seismic Processing
Double Eagle Enterprises	OK	Exploration	3-D Seismic and Surface Microbial
Keener Oil & Gas	OK	Exploration	Telluric Surveys
Cobra Oil & Gas	AL	Formation Evaluation	Schlumberger FMI
Sandia Operating Corp.	TX	Formation Evaluation	Low-Invasion Coring System
Dakota Oil Producers	WY	Improved Oil Recovery	Inert Gas Injection
Diamond Exploration	KS	Improved Oil Recovery	Stimulating Formations Thermally
Edmiston Oil Company	KS	Improved Oil Recovery	Microbial Improved Oil Recovery
X-TRAC Energy, Inc.	UT	Improved Oil Recovery	Solvent Extraction
James Engineering, Inc.	OH	Operations	Computerized Well Monitoring
K-Stewart Petroleum	OK	Production Problems	Improved Well Stimulation
ITM	CA	Production Problems	Resin-Coated Prepacked Gravel
Sipple Petroleum Company	KY	Stimulation	Foam Fracturing
Grace Petroleum	OK	Water Production	Gel Polymer Treatment
Harry A. Spring	OK	Water Production	Cost-Effective Water Disposal
Kenneth Y. Park	OK	Water Production	Gel Polymer
J.R. Pounds	MS	Wellbore Problems	Oxygen Activation Log
Rock Island Services Co.	WV	Wellbore Problems	Microbial Clean-Up of Paraffin
Speir Operating	IN	Wellbore Problems	Microbial Wellbore Clean-Up
Tenison Oil Company	LA	Wellbore Problems	$CaCO_3$ Prevention

Not all of these projects have been completed, and it is not the purpose of this report to give conclusions, only snapshots of the project status at this time. However, 18 of the projects have final results. Of those 18 projects, 15 are a technical success. More time is needed to evaluate whether technical success translates into economic success. One project experienced field or operational problems which prevented evaluating the targeted technology. Although three projects appear unsuccessful, insight concerning limitations of the technologies employed is valuable. The following tables give information on these preliminary results.

Table 2 Final Indications of Technical Success (Completed Projects)

Company	State	Technology	Technical Activity
Brothers Production	TX	Exploration	3-D Seismic Processing
Cobra Oil & Gas	AL	Formation Evaluation	Schlumberger FMI
Dakota Oil Producers	WY	Improved Oil Recovery	Inert Gas Injection
Grace Petroleum	OK	Water Production	Gel Polymer Treatment
Kenneth Y. Park	OK	Water Production	Gel Polymer
Sipple Oil Company	KY	Stimulation	Foam Fracturing
Speir Operating	IN	Wellbore Problems	Microbial Wellbore Clean-Up
K-Stewart Petroleum	OK	Production Problems	Improved Well Stimulation
Tenison Oil Company	LA	Wellbore Problems	$CaCO_3$ Prevention
Sandia Operating Corp.	TX	Formation Evaluation	High-Resolution Logging
J.R. Pounds	MS	Wellbore Problems	Oxygen Activation Log–Located Holes in Casing w/Pressure Testing
Double-Eagle Enterprises	OK	Exploration	2 & 3-D Seismic Processing
Edmiston Oil Co.	KS	Improved Oil Recovery	Microbial Improved Oil Recovery
James Engineering	OH	Operations	Computerized Well Monitoring
Harry A. Spring	OK	Water Production	Cost Effective Water Disposal

Table 3 Lessons learned—Technical Failures (Completed Projects)

Company	State	Technology	Technical Activity
EDCO Oil Company	OH	Drilling	Horizontal Drilling
Keener Oil & Gas	OK	Exploration	Telluric Surveys
Diamond Exploration	KS	Improved Oil Recovery	Stimulating Formations Thermally

DOE/NPTO also administers three other programs that are aimed at larger reservoirs and that involve full-scale field tests: Reservoir Management, Class and Field Demonstrations, and Advanced Demonstrations. The field tests, in most cases, are demonstrating multiple techniques for maintaining production. Additional information about the Reservoir Class Field Demonstration Program is available from Mike Madden (phone, 918-337-4261; e-mail, mmadden@bdmok.com) at BDM-Oklahoma or Herb Tiedemann (phone, 918-699-2017; e-mail, htiedema@npto.doe.gov) at DOE/NPTO.

The Support to Independents effort discussed in this publication is pinpointing specific production problems and attempting to demonstrate lower cost remedies, often focusing on an individual well or group of wells. The project location map (see Figure 1) and technology development contracts table (see Table 1) illustrate the diversity of project locations and technologies.

Current projects and other projects added to the program in the future will be the focus of an extensive technology transfer effort by DOE/NPTO and BDM-Oklahoma. Through workshops, technical reports, and the use of expanding DOE and industry electronic networks, techniques and results from the trial projects will be made available to other producers. For additional information, please contact Herb Carroll (phone, 918-337-4558; e-mail, hcarroll@bdmok.com) at BDM-Oklahoma or Rhonda Lindsey (phone, 918-699-2037; e-mail, rlindsey@npto.doe.gov) at DOE/NPTO.

horizontal drilling for improved well-bore dainage

EDCO PRODUCING
MT. GILEAD, OH

Trempealeau Formation @ 3,088 ft

TECHNOLOGY AREA
- Drilling

PROBLEM
- Heterogeneous Formation
- Low Reservoir Energy

SITUATION
- Low Oil Production

RESULTS
- Project Completed
- Horizontal Well Failed to Improve Production

Background

Oil was discovered in Morrow County, Ohio, in 1961 and started a drilling boom. Numerous wells were drilled because there was no spacing regulation. Consequently, the reservoir energy was prematurely depleted, leaving a significant quantity of oil in this heterogeneous reservoir. The operator proposed to drill a horizontal well to tap into the pools of trapped oil that were thought to exist but were not produced due to compartmentalization and low reservoir energy. The well selected for this project is the Shaver-Neff No. 1 located in Section 15 of Peru Township, Morrow County. Shaver-Neff No. 1 is currently producing 6 barrels of oil and 12 barrels of salt water per day. The oil zone is thick enough to allow a margin of error in the drilling process.

Project Description

To ensure success of the project, the horizontal well drilling method was chosen based on the following criteria:

1. Drilling with air is essential because of the pressure-depleted reservoir.
2. For the same reason, the horizontal wellbore should be close to the vertical wellbore to ensure that the downhole pump can reach the fluid level in the well.
3. A short-radius horizontal well is needed to fulfill criterion 2.

Horizontal Ventures, Inc. was contracted to drill the horizontal well because of its expertise in drilling short-radius horizontal wells. Drilling started in August 7, 1996. A window was milled in 4-1/2 inch casing, and a short radius curve was successfully drilled. The drill pipe stuck and twisted off after approximately 30 feet of the horizontal wellbore was drilled. Attempts at retrieving the drill pipe were unsuccessful. The well was recompleted and put back on production on September 7.

Preliminary Results

After seven weeks of pumping the Shaver-Neff No. 1 well, the production is 2 barrels of oil and 7 barrels of salt water per day. The production rate is less than before drilling the horizontal well. The reason for this disappointing result is the inability of the pump to remain submerged (low fluid level).

Project Funding

A project award of $78,000 (50% DOE, 50% EDCO Producing Inc.) was made to EDCO Producing Inc. for this horizontal well project.

Contact

For more information contact Herb Carroll (918-337-4558) at BDM-Oklahoma, Inc. or Rhonda Lindsey (918-699-2037) at DOE/National Petroleum Technology Office, Tulsa, OK.

computerized well monitoring system

JAMES ENGINEERING
MARIETTA, OH

Clinton/Rose Run
@ 5,000–7,000 ft

TECHNOLOGY AREA
Operations

PROBLEM
Inability to Monitor Quickly and Cost-Effectively a Large Number of Marginal Wells

SITUATION
Not Maximizing the Recovery from Marginal Production

RESULTS
Project Completed

Production efficiency was increased by 5 1/2 %

Background

Most small operators have lean staffing. Therefore, they have difficulties monitoring production regularly. This creates the possibility of lost opportunities to correct well problems promptly and to maximize recovery from marginal wells. James Engineering, Inc. proposes to use a computerized monitoring system to compare forecast production with well production rates to identify problem wells. Then remedial actions can be applied promptly. Successful completion of this project could result in a system that can be economically applied by every operator regardless of size.

Project Description

The goal is to develop simple software to download production forecasts from major commercial reserve analysis software and upload production information from a field or group of wells. This software would also compare actual production with forecast values to identify production declines. Such information will be made available to field personnel so they can identify problems quickly and correct deficiencies as soon as possible.

Results

The project was initiated on May 31, 1996. A computer monitoring and prediction remedial work forecast software package was developed for 240 wells. Preliminary results were favorable.

A paper describing the software developed was presentated at the October 1997 SPE Eastern Regional Meeting in Lexington, Kentucky. The paper included wells successfully identified and corrected by the program. The program also has identified and evaluated many additional wells to determine if production is being optimized.

Modifications to the program, now renamed *Priority*, have included an action column to aid in the follow-through of wells identified for remedial work. Additional changes have been made to facilitate data entry from sources other than Aries. This helps smaller operators who do not have the more sophisticated software packages. *Priority* was placed on the DOE Web site and is available to small operators at www.npto.doe.gov.

The overall results of the program are as follows. During a five-month production period at the end of 1996 and the start of 1997, total production for the 250 wells increased by approximately 5 1/2% over the same period in 1995 and 1996. It should be noted that the nominal decline for these wells is approximately 6% per year. Although all production increases may not be directly attributable to *Priority*, they are indirectly attributable. The indirect increase is because of consistent production monitoring, which caused a change in the attitudes and actions of all participants. Monthly accountability swiftly corrected many problems that previously have gone unaddressed.

Project Funding

DOE made an award for a cost-shared project of $94,000 (50% DOE, 50% James Engineering, Inc.) to James Engineering, Inc. to develop and test this computerized production monitoring system.

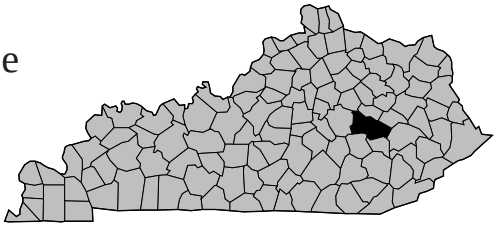
Contact

For more information contact Herb Carroll (918-337-4558) at BDM-Oklahoma, Inc. or Rhonda Lindsey (918-699-2037) at DOE/National Petroleum Technology Office, Tulsa, OK.

foam frac and foam acid treatment

SIPPLE OIL
BEATTYVILLE, KY

Coniferous Dolomite Formation
@ 1,100 ft



TECHNOLOGY AREA
Stimulation

PROBLEM
Water Breakthrough Comes Too Soon After Well Stimulation

SITUATION
Low Oil and High Water Production

RESULTS
Project Completed

Foam Fracturing with Low-Cost Sand Was Successful

Background

Sipple Oil Company (Beattyville, Kentucky) has wells completed in the first, second, and third Coniferous zones (Silurian age) of Big Sinking Field. These wells were producing water or water with only trace amounts of oil. This project compares three stimulation procedures for increasing oil production while reducing water production.

Foam Stimulation

Well No. 41 completed in the second and third Coniferous reservoirs received a foam fracturing treatment with resin-coated sand. Well No. 35 completed in the second and third Coniferous reservoirs received a foam fracturing treatment without resin-coated sand. Well No. 32 completed in the first Coniferous reservoir received a foam acid treatment.

Results of these three stimulation methods were compared. The most successful treatment method will be used in other wells in these reservoirs.

Results

Well No. 41 was stimulated with a foam frac using resin-coated sand in the second and third Coniferous reservoirs. On July 31, 1996, production was 0.5 barrels of oil per day (BOPD) and 4 barrels of water per day (BWPD). Treatment was successful in achieving oil production in this well, but probably was not economical.

Well No. 35 was stimulated with a foam frac using sand as proppant. On July 31, 1996, production was 5.4 BOPD and 5 BWPD. Treatment was successful.

Well No. 32 was stimulated with foam acid treatment in the first Coniferous reservoir. On July 31, 1996, it was producing 0 BOPD and 51 BWPD. Treatment was unsuccessful.

This project demonstrated that foam fracturing with sand proppant is the most economically and technically successful procedure in this type of reservoir.

Project Funding

Sipple Oil Company conducted the stimulation project with a budget of $110,571 (45% DOE, 55% Sipple).

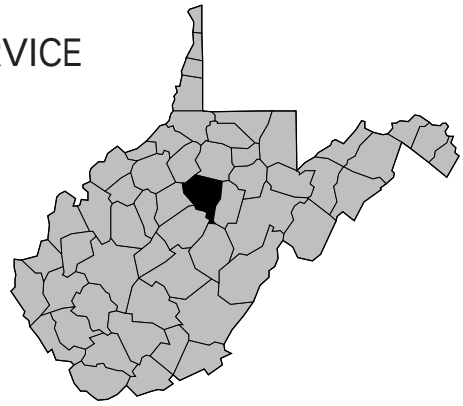
Contact

For more information contact Herb Carroll (918-337-4558) at BDM-Oklahoma, Inc. or Rhonda Lindsey (918-699-2037) at DOE / National Petroleum Technology Office, Tulsa, OK.

microbial cleanup of paraffin

ROCK ISLAND SERVICE COMPANY, INC. CATLETT, VA

Camden Lewis Field
Lewis County, West Virginia
Salt Sand
@ 1700–1800 ft



TECHNOLOGY AREA
Wellbore Problems

PROBLEM
Paraffin Precipitation

SITUATION
Reduced Productivity

RESULTS
Too Early to Tell

Background

Oil has been produced in West Virginia for more than 100 years. Thousands of oil wells there and elsewhere have been prematurely abandoned because paraffin precipitation in the producing formation has caused formation damage, and paraffin precipitation has narrowed production tubing and lead lines. Paraffin precipitation in the reservoir restricts production to uneconomic levels, causing premature abandonment of wells and leaving 90% or more of the recoverable resource in the reservoir unrecovered.

Project Description

Rock Island proposed to inject 1 to 2 gallons of paraffin-mobilizing microbes, 2.5 to 5 gallons of surfactant, 5 to 10 pounds of nutrients, and 400 gallons of water into each of 5 wells in the project. Each well was to be placed back on production after being shut in for a week after treatment. Additional microbial treatment will then be applied as needed.

Preliminary Results

Five wells were treated on June 13th and are back in production. Initial results on June 27 are:

Well	Production Inches	Barrels
McDonald	12	9.84
Jarvis	8	6.56
L White No.1	4	3.28
L White No.2	8	6.56
Camden	2	1.64

Project Funding

DOE made an award for a cost-shared project of $92,859.62 (50% DOE, 50% Rock Island Service Company, Inc.) to Rock Island Service Company, Inc. for this microbial project.

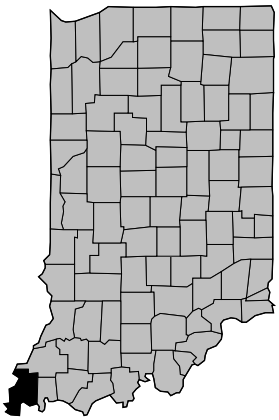
Contact

For more information contact Herb Carroll (918-337-4558) at BDM-Oklahoma, Inc. or Rhonda Lindsey (918-699-2037) at DOE / National Petroleum Technology Office, Tulsa, OK.

microbial wellbore cleanup

SPEIR OPERATING
ALBION, IL

Posey County, IN
Cypress Limestone
@ 2,200 ft



TECHNOLOGY AREA
Wellbore Problems

PROBLEM
Paraffin/Sulfide Scale

SITUATION
Reduced Productivity/ Injectivity

RESULTS
Project Completed

Successful Wellbore Cleanup

Background

Speir Operating Company (Albion, Illinois) conducted a cost-shared project with DOE to evaluate the effectiveness of microbial well treatments for cleaning up production and injection wells. The project, which is located near Evansville in Posey County, Indiana, produces from the Cypress limestone at 2,220 feet. Paraffin and sulfide scale precipitation in perforations, tubing, and the near-wellbore region were reducing oil production, requiring frequent hot oil and acid treatments. Nine producers and two injection wells were involved in the microbial test.

Treatment Procedure

All wells were treated with acid, then operated for about one month prior to receiving the microbial treatments. Wells were treated by injecting 5 barrels of warm water, followed by 10 gallons of microbes and nutrients, followed by a 20-barrel warm water flush. Initial treatments were performed in December 1995. Following the initial treatments, producing wells began cleaning up by unloading sulfide scale, paraffin, and oil-water-paraffin emulsion. Treatments were repeated monthly through May 1996.

Results

Oil production, which initially increased from 7 barrels of oil per day (BOPD) prior to treatment to 21 BOPD, has stabilized at 13–15 BOPD. Injection improved from 20 barrels of water per day (BWPD) at 1650–1700 psig to 25 BWPD at 500 psig. After 5 months, production declined to 6 BOPD plus 25 BWPD, indicating that repeated treatments with less than 6 months frequency are needed to ensure improved oil production rates. The monthly electricity bill was reduced by 32% as a result of lowering injection pressure, although electricity rates increased by 25%.

Project Funding

Speir Operating Company conducted this microbial treatment demonstration project with a budget of $97,550 (50% DOE, 50% Speir).

Contact

For more information contact Herb Carroll (918-337-4558) at BDM-Oklahoma, Inc. or Rhonda Lindsey (918-699-2037) at DOE/ National Petroleum Technology Office, Tulsa, OK.