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IMPROVED OIL RECOVERY
IN FLUVIAL DOMINATED DELTAIC RESERVOIRS OF KANSAS - NEAR-TERM

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(9th Quarterly Report)

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Savonburg Field (6/19/95)

Active Wells (B3 Net Isopach)

Methodologies used on this project were presented as a case study at a seminar titled, "Increasing Profitability in Marginal Oil Fields" , August 24-25, 1995 at Barton County Community College in Great Bend, Kansas.

An abstract titled "Evaluating Waterflood Potential in a Morrow Sandstone Reservoir" was submitted and accepted for the SPE/DOE Tenth Symposium on Improved Oil Recovery April 21-24, 1996 in Tulsa, Oklahoma.

Summary of planned work for next quarter

Methodologies used on this project will be presented as a case study at a seminar titled, "Increasing Profitability in Marginal Oil Fields" , November 29-30, 1995 in Wichita, Kansas.

Information will be prepared for the Stewart Field which will be presented in the Traveling Workshop Series for selected Class 1 near-term projects.

and fiberglass water supply lines were run to the two water supply wells. A 4" fiberglass injection trunkline was trenched and installed over 3 1/2 miles of the length of the field. The 3" fiberglass injection lateral lines were trenched and installed to most of the proposed injection wells. Conversion of 5 of the 6 initial proposed injection wells was completed.

Summary of planned work for next quarter

Run electric submersible pumps in the two water supply wells and finish electrical and supply line hook ups. Finish laying and pressure testing injection lateral lines. Convert remaining proposed initial injection well. Finish plumbing in injection wellheads and injection lines. Prepare for October injection startup.

Task II.3 - Design/Construct Battery Consolidation and Gathering System

Summary of work in last quarter

Concrete tank farm and water supply tankage foundations were poured. Central battery oil tanks (4-1000 bbl) and the central battery heater treater were set. Major piping on the production side was constructed and installed. The majority of the 4" fiberglass gathering line across the length of the field was trenched and installed. Approximately 1/3 of the producing wells were tied into the gathering line to the central tank battery.

Summary of planned work for next quarter

Finish plumbing in central tank battery. Install truck LACT unit. Complete tank farm foundation and dike work. Finish tying in and hooking up producing wells to central gathering line system. Build office/work area and start reclaiming old tank batteries.

Task II.4 - Waterflood Operations and Reservoir Management

Summary of work in last quarter

Hired a company pumper and set up daily information reporting sheets.

Summary of planned work for next quarter

Start water injection during October. Implement data capture/data reporting plan. Monitor production, water supply and injection volumes, injection pressures and well test information.

Task II.5 - Technology Transfer

Summary of work in last quarter

Project information was presented as a poster session at the SPE Forum Series titled, "Multidisciplinary Analysis and Solutions to Rejuvenating Old or Marginal Fields", August 6-11, 1995 in Snowmass Village, Colorado.

Task II.6 - Technology Transfer

Summary of work in last quarter

A one-day workshop titled "Exploitation of Mature Reservoirs - Results on Savonburg Project" was held at Allen County Community College in Iola, Kansas, August 9, 1995.

Methodologies used on this project were presented as a case study at a seminar titled, "Increasing Profitability in Marginal Oil Fields", August 24-25, 1995 at Barton County Community College in Great Bend, Kansas.

An abstract titled "Development of an Improved Waterflood Optimization Program from the Northeast Savonburg Waterflood" was submitted and accepted for the SPE/DOE Tenth Symposium on Improved Oil Recovery April 21-24, 1996 in Tulsa, Oklahoma.

Summary of planned work for next quarter

Methodologies used on this project will be presented as a case study at a seminar titled, "Increasing Profitability in Marginal Oil Fields", November 29-30, 1995 in Wichita, Kansas.

Information will be prepared for the Savonburg Field which will be presented in the Traveling Workshop Series for selected Class 1 near-term projects.

Stewart Field Project

Task II.1 - Design/Construct Waterflood Plant

Summary of work in last quarter

The construction of the water injection building and the major piping to this building have been completed. The injection building contains 2 quintuplex pumps, motors, filtering equipment, suction and discharge piping, pressure recorders, flowmeters, electrical wiring and controls. The injection building is designed for a maximum volume of 10,000 BWPD at 2000 psi. The water supply tankage has been set and is part of the central facility tank farm. The water supply tankage consists of 3-1000 bbl and 1-300 bbl fiberglass tanks. The major plumbing is complete on the water supply tankage.

Summary of planned work for next quarter

Finish plumbing and hooking up water injection plant and finish electrical installation. Prepare for water injection start up in October.

Task II.2 - Design/Construct Injection System

Summary of work in last quarter

The second water supply well (Sherman 3-9) was recompleted in the Topeka formation. Electricity

Task II.4 - Reservoir Development (Polymer Flooding)

Summary of work in last quarter

Equipment to inject polymer was placed on location. The equipment was tested for reliability.

Summary of work for next quarter

It is anticipated that polymer injection could begin during this quarter.

Task II.5 - Field Operations

Summary of work in last quarter

Normal field operations have included: 1) monitoring wells on a daily basis, 2) repairing waterplant, piping, and wells as required, 3) collecting daily rate and pressure data, and 4) solving any other daily field operational problem that might occur.

<u>Month</u>	<u>Oil Production</u>
October 1993	26.4 B/D
November 1993	30.7 B/D
December 1993	32.0 B/D
January 1994	30.8 B/D
February 1994	30.9 B/D
March 1994	30.3 B/D
April 1994	29.1 B/D
May 1994	28.5 B/D
June 1994	30.3 B/D
July 1994	28.9 B/D
August 1994	24.6 B/D
October 1994	23.0 B/D
November 1994	25.7 B/D
December 1994	27.8 B/D
January 1995	27.0 B/D
February 1995	25.3 B/D
March 1995	22.4 B/D
April 1995	22.4 B/D
May 1995	25.0 B/D
June 1995	23.9 B/D
July 1995	26.8 B/D
August 1995	25.2 B/D
September 1995	24.8 B/D

Summary of planned work for next quarter

Field operations will be continued.

Tank pads have been constructed and piping re-vamped and two additional 400-bbl fiberglass tanks have been installed. This will provide adequate clear water storage and allow flexibility for the other vessels to be used for testing to optimize the water treatment process.

Summary of planned work for next quarter

The water plant will be continually monitored and optimized as problems arise. We believe the greatest opportunity lies in the area of metering, monitoring, and controlling the water streams leading into and out of the flotation unit. It has been difficult to maintain constant flotation efficiency at the unit. This is caused by a variation in the percentage of produced and make-up water that is being treated over time. When this mix changes, the constituents of the combined water stream also change, necessitating a variation in the chemical treatment. This problem could be solved by automatically monitoring the water mix and adjusting the chemical feed accordingly. This development would certainly make the technology useable by most operators and applicable over a wide range of conditions.

The problem of the start-up and shut-down of the air flotation unit will be addressed. A valve will be installed to regulate the flow of raw water to the air flotation unit.

Task II.2 - Profile Modification Treatments

Summary of work in last quarter

No treatments were conducted.

Summary of work planned for next quarter

We plan to conduct at least three polymer gel treatments in the next quarter.

Task II.3 - Pattern Changes and Wellbore Cleanup

Summary of work in last quarter

In the month of July, Well No. RW-1 was washed, jetted, and acidized. After a top-hole casing repair, the well was reactivated and placed back on injection. Coiled tubing acid and chemical treatments were performed on injection wells RW-9, RW-12, and H-12. K-50 was reactivated and received two small acid/chemical treatments. Tubing leak problems occurred in converted injection H-5. A tubing string was replaced.

In the month of August, seven producing wells were pulled, H-16, H-21, H-30, K-41, and K-43.

In the month of September, the following injection wells were treated by coil tubing: KCW-1, KW-6, KW-7, KW-8, KW-10, RW-12, and RW-13. Each treatment consisted of 25 gallons of 28% hydrochloric acid with our normal chemical additives. Five producing wells were serviced, H-24, H-25, K-41, and K-54.

Summary of planned work for next quarter

A well will be drilled in the location described on the figure entitled Active Wells (B3 Net Isopach).

Objectives

The objective of this project is to address waterflood problems of the type found in Cherokee Group reservoirs in southeastern Kansas and in Morrow sandstone reservoirs in southwestern Kansas. Two demonstration sites operated by different independent oil operators are involved in the project. The Nelson Lease (an existing waterflood) is located in Allen County, Kansas in the N.E. Savonburg Field and is operated by James E. Russell Petroleum, Inc. The Stewart Field (on latter stage of primary production) is located in Finney County, Kansas and is operated by North American Resources Company.

General topics to be addressed will be 1) reservoir management and performance evaluation, 2) waterflood optimization, and 3) the demonstration of recovery processes involving off-the-shelf technologies which can be used to enhance waterflood recovery, increase reserves, and reduce the abandonment rate of these reservoir types.

The reservoir management portion of the project will involve performance evaluation and will include such work as 1) reservoir characterization and the development of a reservoir database, 2) identification of operational problems, 3) identification of near wellbore problems, 4) identification of unrecovered mobile oil and estimation of recovery factors, and 5) identification of the most efficient and economical recovery process.

The waterflood optimization portion of the project involves only the Nelson Lease. It will be based on the performance evaluation and will involve 1) design and implementation of a water cleanup system for the waterflood, 2) application of well remedial work such as polymer gel treatments to improve vertical sweep efficiency, and 3) changes in waterflood patterns to increase sweep efficiency.

Finally, it is planned to implement an improved recovery process on both field demonstration sites.

Summary of Technical Progress

Savonburg Field Project

Task II.1 - Water Plant Development

Summary of work in last quarter

The air flotation unit forms a froth on top of the water level which is removed as part of the water clean up process. It has been determined that the froth has not been removed appropriately. Therefore the top of the air flotation unit has been removed to modify the slop weir. It has become obvious that the hydraulic induced circulation was not as good as thought. The slop weir was modified and a froth wiper has been installed to remove the foam rapidly from the surface of the water. The intentions are to prevent the large bubbles from forming. The entrained solids from the collapse of a large bubble tend to sink in the air flotation tank and carry over to the clean water weir.

A small-scale test of the Consolidated Electro-Floc process was conducted. The water stream was split immediately ahead of the air flotation unit. A portion of the stream was passed through the device, consisting of a series of aluminum plates with a small voltage imposed across them. A strong floc was consistently formed. However, it appeared that retention time through the flotation unit was inadequate to achieve the full affect.