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FIELD VERIFICATION OF CO_2-FOAM

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New Mexico Institute of Mining and Technology
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Anticipated Completion Date:	September 28, 1993
Funding for FY 1992:	$600,000

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Reporting Period:	July 1 to September 30, 1992

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OBJECTIVES

This project is a cooperative industry-university-government effort to transfer laboratory research technology to a field demonstration test. The primary objective of the project is to evaluate the use of foam for mobility control in a field-scale CO_2 flood.

SUMMARY OF TECHNICAL PROGRESS

The East Vacuum Grayburg/San Andres Unit (EVGSAU), operated by Phillips Petroleum Company, is the site selected for a comprehensive evaluation of the use of foam for improving the effectiveness of a CO_2 flood. The four-year project, jointly funded by the EVGSAU Working Interest Owners (WIO), the U.S. Department of Energy (DOE), and the State of New Mexico, began in late 1989. The Petroleum Recovery Research Center (PRRC), a division of the New Mexico Institute of Mining and Technology (NMIMT), is providing laboratory and research support for the project. A Joint Project Advisory Team (JPAT) composed of technical representatives from several major oil companies provides input, review, and guidance for the project.

Results of laboratory work leading to the selection of a specific foaming surfactant for application at EVGSAU and additional background on the project were presented[1] at the SPE/DOE Eighth Symposium on EOR in April 1992. During this quarter, a second paper[2] outlining the field operating plans, design criteria, foam injection schedule, data collection program, and performance criteria was presented at the 1992 SPE Annual Technical Conference and Exhibition.

Project Design

The design approved by the JPAT for the EVGSAU field test includes the injection of three months of a pre-foam surfactant pad, followed by the injection of an 80% quality CO_2-foam during four months of a rapid surfactant-alternating-gas (SAG) cycle. The surfactant pad both satisfies the adsorption and compensates for the adsorption-induced retardation of the surfactant band. This will result in effective utilization of surfactant for foam generation. The rapid SAG cycle, consisting of three days of surfactant solution injection followed by 12 days of CO_2, was selected to avoid operational problems of coinjection while achieving the benefits of simultaneous injection.

Prior to the initiation of the rapid SAG cycle, a meeting of the JPAT was held in Houston, TX on July 7, 1992, to review results obtained to date and finalize plans for foam generation. In both the pre-foam pad and in the surfactant solution for the SAG cycle, the design called for 2500 ppm Chevron Chaser CD-1045.®

Foam Injection and Monitoring

The pre-foam surfactant pad injection was started in April 14, 1992 and completed on July 14, 1992. The injected surfactant concentration was maintained close to the design of 2500 ppm. Injection well profile tests indicate that the surfactant solution was leaving the wellbore in the higher permeability zones that had previously received water only.

Following the three months of pre-foam surfactant pad, water was injected for three days to displace the surfactant solution from the immediate vicinity of the wellbore. On July 17, 1992, the rapid SAG cycle began.

Injection rates and pressures are monitored daily at the pattern injector (Well 3332-001). Figure 1 shows the injection well performance from the baseline period through the surfactant adsorption slug and into the rapid SAG cycle. At the injection rate of 1000 BWPD, wellhead pressure typically increases when the injection is switched from water to CO_2. This behavior is quite evident during the rapid WAG cycle. The higher injection pressures during the rapid SAG cycle is attributed to in-situ foam generation. An expanded plot of the rate and pressure data for the rapid SAG cycle is shown in Fig. 2. At the completion of the rapid SAG cycle, the surface pressures will be converted to bottomhole conditions so that injectivities and Hall Plots can be used to monitor results of the test.

Several injection profiles were obtained in the rapid SAG cycle during both CO_2 and surfactant solution injection. These profiles suggest that all fluids are continuing to enter the higher permeability zones although a slight decrease (10-15%) has occurred in the highest permeability "C" Zone.

Production from the eight wells in the foam pattern is monitored weekly. As expected, no significant production changes in the pattern wells have been observed at this early stage of the foam injection test.

Project Plans

The fifth cycle of foam generation, which will complete the rapid SAG injection test, is scheduled to be completed in early October 1992. Plans then call for three months of CO_2 injection. The injection well and the producing wells in the pattern area will continue to be monitored.

The next JPAT meeting is scheduled on November 9, 1992, to discuss progress of the test and to establish the future course of action. In particular, the desirability of a second foam generation test will be addressed.

REFERENCES

1. Martin, F.D., Heller, J.P., Weiss, W.W., Tsau, J., Zornes, D.R., Sugg, L.A., Stevens, J.E., and Kim, J.E.: "CO_2-Foam Field Verification Pilot Test at EVGSAU Injection Project Phase I: Project Planning and Initial Results," paper SPE/DOE 24176 presented at the Eighth Symposium on Enhanced Oil Recovery, Tulsa, OK, April 22-24, 1992.

2. Stevens, J.E., Harpole, K.J., Zornes, D.R., and Martin, F.D.: "CO_2 Foam Field Verification Pilot Test at EVGSAU Phase II: Foam Injection Design and Operating Plan," paper SPE 24642 presented at the 67th Annual Technical Conference at Exhibition of the SPE, Washington, D.C., October 4-7, 1992.

Figure 1

3332-001 Injection Pressure and Rate
July 1, 1991 - September 30, 1992

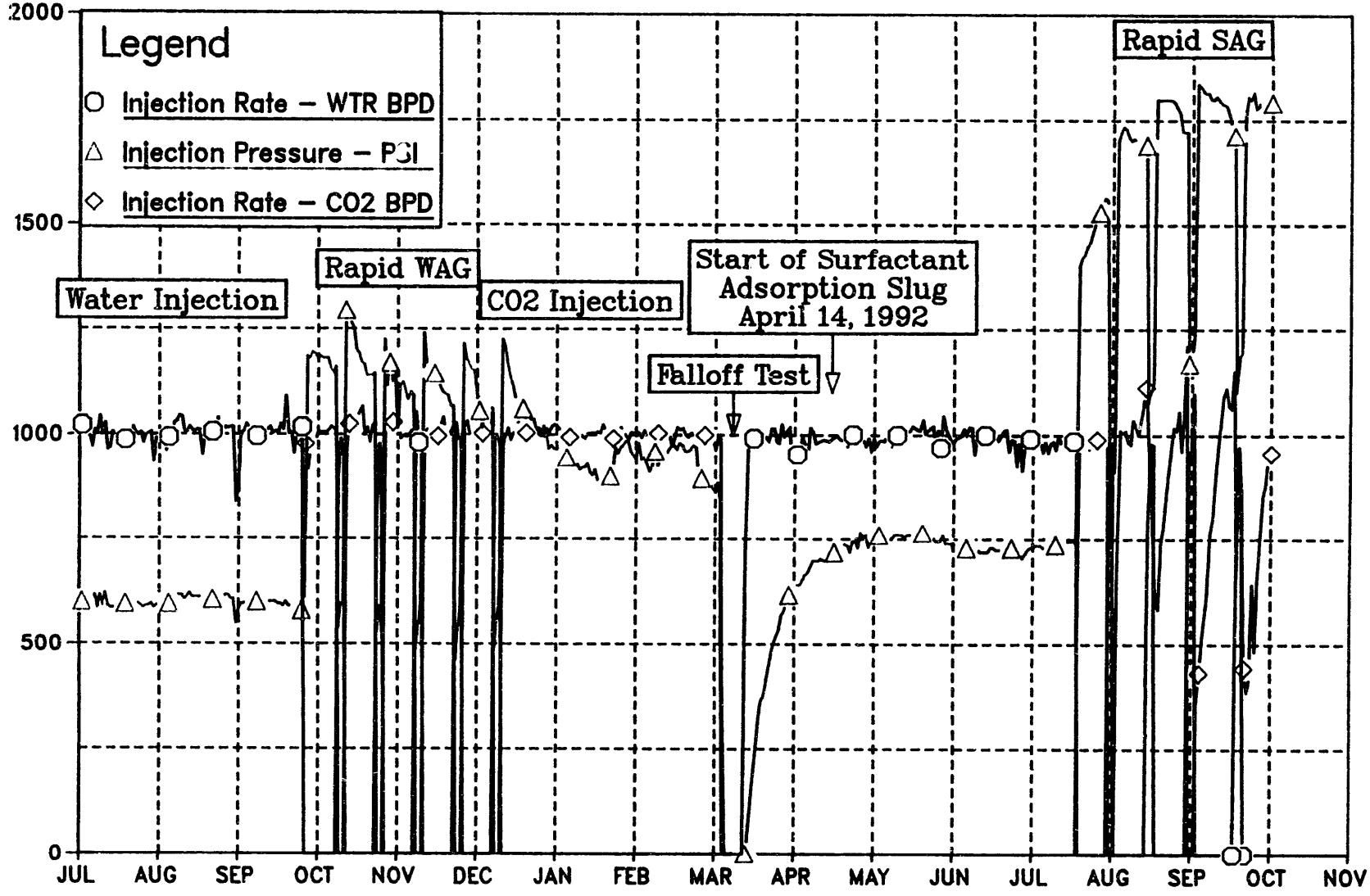
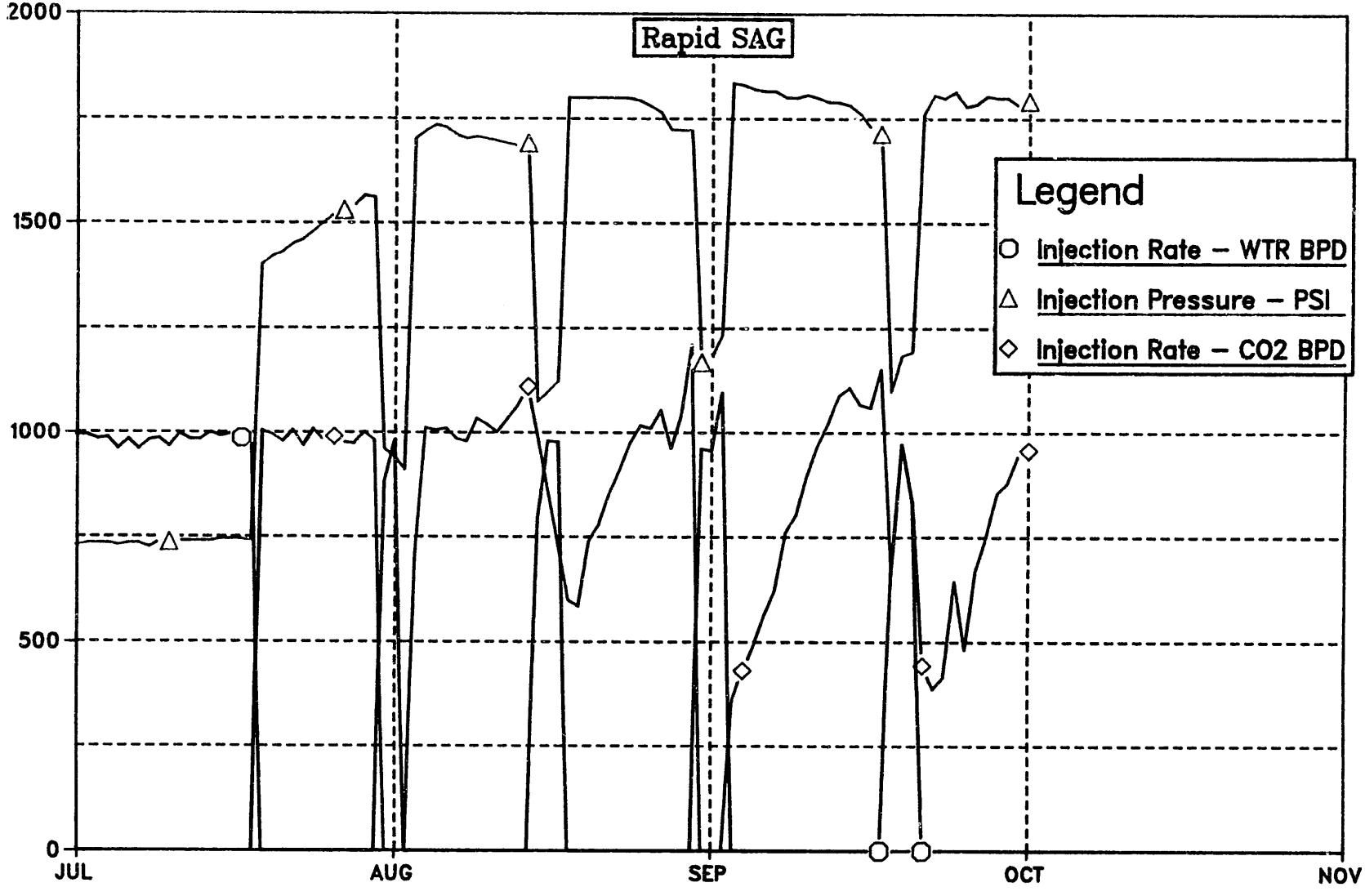


Figure 2

3332-001 Injection Pressure and Rate
July 1, 1992 - September 30, 1992



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