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In Stripper Gas Wells

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Abstract

The goal of this research program is to develop and deliver a procedure guide of low cost methodologies to analyze and correct problems with stripper wells experiencing abnormal production declines.

A study group of wells will provide data to determine the historic frequency of the problem of abnormal production declines in stripper gas wells and the historic frequency of the causes of the production problems. Once the most frequently occurring causes of the production problems are determined, data collection forms and decision trees will be designed to cost-effectively diagnose these problems and suggest corrective action. Finally, economic techniques to solve the most frequently occurring problems will be researched and implemented. These systematic methodologies and techniques will increase the efficiency of problem assessment and implementation of solutions for stripper gas wells.

This first quarterly technical report describes the data reduction and methodology to establish a study group of stripper gas wells in which Artex Oil Company or its affiliate, Arloma Corporation, own a working or royalty interest. The report describes the procedures to define wells exhibiting abnormal decline and identify the associated problem. Finally, the report discusses initial development of diagnostic procedures to evaluate the cause of abnormal production declines.

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List of Graphical Materials

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Introduction

The goal of this research program is to develop and deliver a procedure guide of low cost methodologies to analyze and correct problems with stripper wells experiencing abnormal production declines.

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The following is the first quarterly technical report which addresses the data reduction methods and conclusions for each of the following tasks: 1) Establish a Study Group of Stripper Gas Wells, 2) Review and Identify Problem Wells Exhibiting Abnormal Decline, and, 3) Begin the Development of Diagnostic Tools and Methods.

Executive Summary

The goal of this research program is to develop and deliver a procedure guide of low-cost methodologies to analyze and correct problems with stripper wells experiencing abnormal production declines.

A study group of wells will provide data to determine the historic frequency of the problem of abnormal production declines in stripper gas wells and the historic frequency of the causes of the production problems. Once the most frequently occurring causes of the production problems are determined, data collection forms and decision trees will be designed to cost-effectively diagnose these problems and suggest corrective action. Finally, economic techniques to solve the most frequently occurring problems will be researched and implemented. These systematic methodologies and techniques will increase the efficiency of problem assessment and implementation of solutions for stripper gas wells.

This first quarterly technical report describes the results of the first three tasks: 1) Establish a Study Group of Stripper Gas Wells, 2) Review and Identify Problem Wells Exhibiting Abnormal Decline, and 3) Begin Development of Diagnostic Tools and Methodologies.

The first task was to establish a data reduction and methodologies for a study group of stripper gas wells in which Artex Oil Company or its affiliate, Arloma Corporation had a working interest or royalty interest. The study group was reduced to include wells operated by Artex Oil Company because of greater ability to access information, collect and interpret data, and to more closely affect the outcome of recommended procedures. The study group was further reduced to exclude wells sold, plugged, or having incomplete production information.

James Engineering, Inc. utilized ARIES®, a database management software, offered by Landmark Graphics, to manage master, product and economic tables and provide the production plotting function utilized in the analysis of abnormal production declines. The master table was populated with pertinent data. The production data tables were reviewed and updated to complete the historic production data where possible. Forty-year production plots were prepared for each well and analyzed for abnormal production decline.

A production decline type curve was obtained for the Clinton Sand formation based upon extensive production analysis and experience in the Appalachian Basin. The type curve was compared to the forty-year production plots to determine which wells exhibited abnormal production decline. Abnormal production decline is defined as a consecutive three-month period where the production fell below the type curve forecast by 50%. During the course of the analysis of individual wells, the cause of the abnormal decline and the corrective action were identified and documented if known.

Finally, preliminary data forms are being designed to assist in developing diagnostic tools and methods to evaluate the cause of abnormal production declines in the study group of wells.

Experimental

No experimental methods, materials, or equipment were used in this phase of the research.

Results and Discussion

According to the timeline provided by James Engineering, Inc. to the Federal Energy Technical Center, James Engineering, Inc. was to accomplish the following tasks by December 31, 1999:

1. Establish a Study Group of Stripper Gas Wells
2. Review and Identify Problem Wells Exhibiting Abnormal Decline
3. Begin the Development of Diagnostic Tools

Each section as identified above will be reviewed in detail and describe the methodology utilized.

Task 1 – Establish a Study Group of Stripper Gas Wells

“The contractor shall establish a study group of stripper gas wells from a group of over 500 wells which they have access to. The study group shall include wells of various depths with a wide variety of producing mechanisms. The wells will be primarily located in the Appalachian Basin, but may also include some wells in the Permian and Powder River Basin.”

Data Reduction and Methodology

The database of wells used in this study contained all wells in which Artex Oil Company or its affiliate, Arloma Corporation, had a working or royalty interest. The Artex Oil Company database consists of 592 wells located in Kansas, New Mexico, Ohio, Texas, West Virginia and Wyoming. The study group was reduced to wells operated by Artex Oil Company because of the ability to access information, collect and interpret data and to more closely affect the outcome of recommended procedures. This reduced the study group to 459 wells. Wells that have been sold, plugged, or classified as non-stripper were eliminated reducing the study group to 434 wells. The 434 wells utilized for the study group mainly produced from the Clinton Sand formation and are located primarily in Guernsey, Muskingum, Morgan, Noble, Tuscarawas and Washington counties in Ohio.

James Engineering, Inc. utilized ARIES®, a database management software offered by Landmark Graphics. In addition to many other features, this software offers the ability to manage master, product and economic tables, and also includes a production plotting function that was used to help analyze abnormal production declines.

A review of the ARIES® Master Table was performed for each well to ensure that each was complete with the following information: permit number, completion data, total depth, perforated interval, producing reservoir, and producing mechanism. The completion date was updated on each well and then compared to the production table to determine if a complete production history was available. As many gaps as possible in the production history were filled in from production data available from two state-

maintained databases and other sources. The databases maintained by the state are the Risk Based Database Management System, or RDBMS, and the Production of Oil and Gas database, or POGO, maintained by the Ohio Division of Natural Resources, Division of Oil & Gas and the Geological Survey, respectively.

A semi-log plot of monthly oil and gas production from the ARIES® Product Table was prepared on a forty-year graph for each well. The title block for each production plot contained the lease name, well number, county, state, well type, completion date, producing reservoir, producing mechanism, and total depth. See Appendix No. 1 for an example of a typical production plot utilized for production decline review.

At this point the decline curves were ready to be analyzed for abnormal production decline. From this analysis, wells having insufficient production data were eliminated, reducing the study group to 396 wells. Insufficient production data for this study is defined as monthly oil or gas data insufficient to accurately forecast production decline. The incomplete data could be missing early history data or intermittent production information, or have allocated production data. In many cases these were poorer wells at or near their economic limit.

In summary, the methodology to “Establish a Study Group of Stripper Gas Wells” was as follows:

1. Utilize all wells in Artex Oil Company ARIES® database.
2. Eliminate all outside operated wells.
3. Eliminate wells that have been sold, plugged, shut-in or classified as non-stripper.
4. Establish completion date in ARIES® Master Table for all wells in database.
5. Review completeness of monthly production data in ARIES® Product Table.
6. Enter additional product table data in ARIES® Product Table available from RDBMS or POGO or other sources.
7. Enter total depth, producing reservoir, producing mechanism, and perforation interval from well file and completion report information in ARIES® Master Table.
8. Plot monthly oil and gas production volumes from the ARIES® Master and Product tables for all study group wells on a forty-year semi-log plot for abnormal production decline review.
9. Eliminate wells having insufficient production data from the study group.

Task 2 – Review and Identify Problem Wells exhibiting Abnormal Declines

“The contractor shall review and identify problem wells exhibiting abnormal declines from the study group of wells. This task shall be accomplished by taking the historical production information for the group of study wells and plotting the data on decline curves to present a historical perspective of how the wells have performed over their lives. Wells with greater than a 50% departure from an established decline trend for more than three months will be selected for analysis. A statistical analysis of the number of wells meeting this criterion will be prepared. The analysis shall include documenting wells that have declined and have been corrected, the cause of the decline, and the methods used to return the well to economic production.”

Data Reduction and Methodology

A production decline type curve was obtained for the Clinton Sand formation based upon extensive production analysis and experience in the Appalachian Basin. A graphical presentation of this rate time curve on a semi-log plot is included as Appendix No. 2. The type curve was overlaid on each production plot to attempt to match the actual production decline. The type curve was transferred and compared to actual monthly production, then each curve was reviewed for abnormal production declines. An abnormal production decline was defined in our scope of work as a consecutive three- month period where the production fell below the type curve forecast by 50%. Each period of abnormal production meeting this criterion was identified on the curves remaining in the study group.

Forty-three (43) wells were identified which exhibited no abnormal production decline. Three hundred fifty-three (353) wells exhibited some form of abnormal production decline. It is significant that over 85% of the wells in the study group exhibited some sort of abnormal production decline.

Two analyses were performed on each well to determine abnormal production decline. The first analysis included abnormal declines over the entire life of the well. The second analysis focused on abnormal declines during the most recent five-year period or 01-01-95 to 12-31-99. The five-year period represented time in which the current management has operated the wells and more detailed information was available. The total months of abnormal production were compiled for both the entire well life and the most recent five-year period. In addition, it was noted whether action taken to correct the abnormal production decline was permanently or intermittently obtained. Finally, the cause of the decline, if known, was noted and the corrective action, if known, documented. The corrective actions will be further studied through well records and field reports then denoted as a mechanical and/or procedural.

In summary, the methodology to “Review and Identify Problem Wells Exhibiting Abnormal Declines” is as follows:

1. Develop a 40-year production decline type curve for the Clinton Sand formation.
2. Transfer the 40-year production decline type curve to match the actual production plot.
3. Review each well for abnormal production decline.
4. Identify those wells not exhibiting abnormal production decline.
5. Identify abnormal production decline on each production well.
6. Identify cause of abnormal production decline, if known.
7. Identify the method used to return the well to production, if known.

Task 3 – Develop Diagnostic Tools to Evaluate the Cause of Declined Production in Problem Wells

“Develop data-collection forms of pertinent information to assist in analysis of problem wells. Well equipment will be analyzed for mechanical failure. Shut-in and producing pressure information will be gathered to analyze bottom hole producing pressures. Fluid levels and other information will be collected to determine the effects of fluid on bottom hole pressure. Fluid production histories will be confirmed to determine what effect gas/liquid ratios have on stripper gas well performance. Pressure drops from producing formation to the gas sales point will be analyzed.

Data Reduction and Methodology

Preliminary data collection forms are being compiled for use in this phase of the study. Further analysis is required to develop the proper forms necessary to assimilate all pertinent data required for complete diagnosis of abnormal production decline. In addition, some preliminary efforts have been made to flow chart the production data evaluation methodology. More work will be required to develop this process. The time period for completion of this task is 12-01-99 to 03-31-2000.

Conclusion

The group of 592 wells was reduced to eliminate wells in which we had either insufficient amount of information to analyze or were not applicable to the study. This reduction resulted in a study group of 426 wells located primarily in Ohio and operated by Artex Oil Company. The next step was to analyze wells exhibiting abnormal production declines which is defined as a consecutive three-month period where the production fell below the type curve forecast by 50%. For wells experiencing abnormal production declines, the cause was identified, if known. The last task was to begin the development of diagnostic tools and methods to analyze the causes of abnormal production decline.

We determined the frequency of abnormal production declines for the reduced study group to be over 85%. Development of diagnostic tools will help determine the most likely causes of production declines. However, our preliminary analysis indicates the most common cause of abnormal production decline appears to be excessive pressure on the producing formation and not an issue of formation damage.

References

Not applicable.

Bibliography

Not applicable.

List of Acronyms and Abbreviations

Not applicable.

Appendices

Appendix 1 Sample ARIES Production Decline Curve Plot, Barstow #3

Appendix 2 Clinton Sand Formation Production Decline Type Curve

APPENDIX 1
LEASE: BARSTOW #3-LPV
PERMIT: 34-059-2-3696
COUNTY: GUERNSEY
WELL TYPE: CP
RESERVOIR: CLINTON
STATE: OH
COMP DATE: 10/01/86
DEPTH: 4776