EVALUATING THE IMPACT OF ACCURATE ROD STRING SPACING RELATIVE TO THE ROD PUMP ON WELL PERFORMANCE & MAINTENANCE COSTS

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INTRODUCTION/ BACKGROUND

Inaccurate rod string spacing on rod pumped wells may result in significant maintenance costs and well productivity issues. To avoid unnecessary pump damage and optimize pump performance, precise placement of the rod string is key. This session will explore how a dual purpose well spacing tool /rod rotator addresses the need to adjust the rod string while harnessing benefits of a rod rotator.

Traditional methods of adjusting the rod string requires removal of rod clamps and exposes field personnel to pinch, fall and struck-by hazards. To mitigate this risk, some E&P companies require a third-party to adjust rod string spacing, resulting in significant time and incremental expense. Subsequently, rod string adjustments may not be prioritized leading to an increase in rod pump damage and sub-optimal performance. This paper will explore how using a new tool to fine tune well spacing improves safety and well performance, while reducing maintenance costs. It will review current practices related to rod string adjustments, review install considerations and examine key performance indicators typically evaluated to assess success. It will conclude with a summary of field install findings and conclusions.

SITUATIONAL ANALYSIS

While alternative approaches to rod pump design, rod strings and rod guide placement have been widely incorporated and explored in the field, limited study has occurred to address problems and issues stemming from improper placement of the rod string and inadequate rod rotator longevity.

Rod String spacing has been viewed as more art than science, however new solutions and technology are enabling improved monitoring of rod pump performance and surface equipment conditions, providing optimization opportunities.

PROBLEMS/ ISSUES

Recurring problems in the field related to rod string adjustments and rod rotator performance include:

- Lack of accurate placement when adjusting the rod string relative to the rod pump leads to sub-optimal pump performance and decreased well productivity.
- Rod rotators previously designed for vertical wells may experience more frequent failures when placed in horizontal well applications. Furthermore, these failures may go undetected resulting in rod string damage or necessitating rod string replacement, leading to costly workovers.
- Gas interference creates inadequate rod pump fillage and subsequent declines in well productivity. Traditionally this issue may have been addressed by tagging, which can damage the pump. While it is not a recommended practice, tagging still occurs.
- Liability and safety concerns lead to third party companies being engaged to complete rod string adjustments which increases the time and expense associated with rod string adjustments.
- Elevated levels of risk and hazard exposure occur for field personnel (internal and external) when adjusting the rod string or replacing the rod rotator due to hazards associated with working at heights and the potential for pinch or drop incidents.
- Increased traffic at the well site due to downtime and/ or sub-optimal well productivity results in additional costs due to labor and travel expenses.
- The time and expense associated rod string adjustments and verifying rod rotator performance may result in lower well productivity and higher overall pump and rod string maintenance costs.

POTENTIAL SOLUTION

Implement a dual-purpose tool that eliminates the need to remove the rod clamps when adjusting the rod string. This reduces the time, physical demands and exposure to hazards when working at heights, while allowing accuracy (to $1/8^{th}$ of an inch) when spacing the rod string relative to the rod pump.

How it Works:

- Functions as traditional rod rotator until rod string adjustment is required.
- Converts to rod string adjustment tool when actuator arm is removed & adjuster nuts are loosened. Removal of rod clamps is not necessary to adjust rod string.
- Custom carrier bar accommodates 20” spindle to permit height adjustability. Requires “button” bridle cable end termination and adequate clearance from the wellhead. This is validated by completion of a Pre-Install Sheet.
- When ideal spacing is achieved, adjustment nuts are tightened & actuator arm is re-attached. Tool returns to traditional rod rotator functionality.

- Longevity and higher torque capacity facilitated by higher capacity bearing arrangement and robust gearing mechanism to continuously rotate the rod string to reduce rod wear.

KEY PERFORMANCE INDICATORS FOR FIELD INSTALLS

1) Safety - Eliminate need to remove rod clamps to make rod string adjustments thereby reducing hazards and time spent at height.
2) Precision – Evaluate how height adjustability permits fine tuning & precise placement of rod string. Explore how precise placement of the rod string impacted pump performance and the need for future adjustments.
3) Longevity - Demonstrate how longer life of the rod rotator and fewer rod rotator failures to extend rod string life and reduces rod rotator replacement costs.
4) Ease of Adjustment – Determine if improving ease of adjustments altered the frequency, nature (internal versus external personnel) or likelihood of adjustments to optimize productivity.
5) Cost Savings – Quantify savings generated by reduced well downtime, labor and rod pump repair costs.

INSTALL CONSIDERATIONS FOR CANDIDATE WELLS

Prior to installs, a detailed Pre-Install Worksheet is completed in the field and reviewed for verification of clearances and to confirm carrier bar size, bridle cables and load cell needs. The following questions were discussed to determine potential to achieve KPI's for the project:

- What is the current process for rod string adjustments? Internal /External?
- How frequent were rod string adjustments required and was it currently optimal or impacted by other factors?
- Were the wells located in areas with similar issues and challenges related to spacing out the rod string relative to the pump?
- Is improving rod pump performance and reducing rod pump maintenance costs a priority?
- Is the well automated and equipped with a load cell? If so, will they consider moving to a wireless load cell?

Wireless Load Cell Requirement:

If a load cell is currently in place, transitioning to a wireless load cell is required. The additional benefit of a decrease in broken wire cables and subsequent damage is realized.

A wireless load cell is required due to the spindle of the tool, which permits height adjustability and bears the weight of the rod string during adjustments. The OD of the spindle exceeds the ID of most standard wired load cells. This necessitates the wireless spindle sit above the tool and spin within the confines of the bridle cables. This requires the load cell to have strong signal reliability and transmissibility.

FIELD INSTALL PACKAGE ELEMENTS:

- Dual Purpose Rod String Adjustment/ Rod Rotator Tool
- Custom Carrier Bar
- Levelling Plate

*If a Wireless Load cell is required, the tool is packaged with load spacers and a wireless load cell.

FIELD PILOT INSTALL SUMMARY FINDINGS

Observations below based on a total of 17 field installs:

- Pumping unit sizes vary from 160s to 912's from a variety of manufacturers.
- All installs were on previously installed beam pumping units versus new pumping unit installations.
- Installs completed on wells ranging in age from 2 to 40 years.
- Average well depth was between 6200 ft – 8950 ft with one well up to 14,000 ft
- Frequency of adjustments required on wells with the dual-purpose rod string adjustment/ rod rotator tool decreased from 25% to 80%
- Time required to complete the adjustment was decreased by 50%
- 25% of the installs had a wireless load cell.
- Well productivity remained the same or increased in all cases due to reduced downtime and enhanced rod pump efficiency.
- KPI's were achieved or exceeded in 83% of cases.

CONCLUSIONS

The tool met or exceeded expectations. Key factors influencing successful field pilots include:

-Timely completion and return of the Pre-Install sheet to verify clearances and package requirements.

-Allowing adequate time to order and acquire new bridle cables/ wireless load cells is a key success factor for a smooth installation.

-Longevity of the rod rotator continues to exceed expectations relative to previous rod rotator experiences

-Additional field installs with wireless load cells are valued to further validate field performance in a variety of conditions.

-Support for the field installs at the production engineer, field foreman and lease operator level are all important for the success of the field pilots

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