REVIEW OF FIELD DATA TO EVALUATE IMPACT ON OVERALL MAINTENANCE COSTS WHEN ROD STRING SPACING TOOL/ROD ROTATOR IS IMPLEMENTED WITH A WIRELESS LOAD CELL

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As companies seek to optimize performance of rod pumped wells, they examine common problems which may include improper rod string spacing resulting in rod pump damage and rod failures. Traditional methods of adjusting rod strings 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 expense.

This session will explore how using a new tool to fine tune well spacing reduces safety hazard exposure and risk associated with rod string adjustments. It will discuss how precise placement of the rod string impacts rod pump maintenance and well productivity based on data from E&P companies who have implemented this new well spacing tool/ rod rotator between Dec 2017 – May 2021. The analysis will include findings quantifying the impact of pairing this rod string adjustment tool with new wireless load cell technology on field operations / maintenance costs.

PROBLEM: Gas interference demands appropriate rod string spacing relative to the rod pump to minimize the effect of inadequate rod pump fillage and subsequent declines in well productivity. Traditionally, this may have resulted in tagging a well when well productivity has been impacted by gas or solids interference. Rod string adjustments may necessitate the expense and time associated with the use of a third party, depending on the policy of the producer.

CURRENT SITUATION**:** Adjustment of the rod string in a traditional manner requires removal of the rod clamps and is a time consuming, iterative process that exposes personnel to numerous pinch/ struck by hazards. As a result, rod string adjustments may be being delayed unnecessarily due to the difficulty of the task, time required, or availability of third-party service companies. The net effect may be wells where rod pump performance is not always optimized due to improper rod string spacing or wells may be left tagging, resulting in substantial rod pump damage and maintenance costs. Tagging is not recommended.

BACKGROUND/ SOLUTION**:** The RotaTap tool eliminates the need to remove the rod clamps when adjusting the rod string and has been tested in the field for 5 years and is on its' third generation of the design, as it begins commercialization.

Feedback from field trials have enhanced operability and reliability, as well as provided greater understanding of the value proposition to end users. A major Canadian oil producer was the first client to adopt the technology and the first RotaTap tool installed with them in December 2017. Based on that successful installation, an additional 10 units were purchased in the fall of 2018. As the tool is installed in different regions in the Western Canadian Sedimentary Basin, the reliability and operability continue to deliver exceptional results and is beginning to generate awareness.

The RotaTap tool has two distinct situations where it adds value: 1) on existing pumpjack installations where frequent rod string adjustments are necessary, and the improved ease and safety of rod string adjustment is highly valued and 2) on newly installed rod pumped wells where rod string adjustments are frequent, while the well begins pumping and the new rod string stretches with the load.

CASE STUDY RESULTS:

PRODUCER A (ROTATAP - NO LOAD CELL)
Install RotaTap Date: May 1, 2019
Producing Formation: Bakken (Canadian side)
Previous Production Results: Nov 20, 2018 = 8.74 bopd
1 Week Post Install Production Results: May 7, 2019 = 17.3 bopd

Reference Table 1 and Table 2 for historical well test data and production rates.

Comments from Field Engineer:

“The payout on this Rototap is 2 weeks if this holds. The well tested 17.3 bopd, up 8.5 bopd from the previous test of 8.74 bopd.17.3 bopd is the best test we’ve had since at least 2011.We are less than 2” off tap. I was hoping the Rototap would prevent the gas locking. I wasn’t expecting to get an extra 8.5 bopd by preventing that gas locking. These wells in Pierson are all pumped off. With the fluid level at the PSN, I was not expecting to see this kind of increase.”

Subsequent testing revealed the initial result of doubled production, could likely be partly attributed to flush production. However, tests taken May 21, 2019 revealed production still maintained an increase to 13.9 bopd.

OBSERVATIONS:

Update: June 7th, 2019 – 5 weeks post install of RotaTap, conversation with Field Engineer:

ROI on investment in RotaTap paid off in the first few weeks, based on production increase. To date this well remains working well, with production levelled off and maintained an additional 1 bpd. No additional spacing has been required since the RotaTap was installed and savings are estimated to be $3400/ month based on the producer’s historical maintenance spend on this well location.

Short Term: Most significant benefit is no intervention or downtime on well since install = improved efficiency and overall production. Reduced third party expense.

Long Term: Rod pump longevity and reduced overall maintenance costs as a result of fine tuning of the rod string. Safety on well improved by reducing risk and frequency of exposure to hazards when adjusting rod string.

PRODUCER B (ROTOTAP - NO LOAD CELL)
Install Dates: Between May – August 2020 3 units were installed
Producing Formation: Cardium
Well Profiles: All horizonal/ non-deviated wells ranging in total depth between 10,912 ft to 14,271 ft
Production Ranges: 10 bopd to 23 bopd
Pumping Units: 640 Maximizers

OBSERVATIONS:

April 15, 2021 “RotaTap was selected because existing rod rotators were failing and requiring monthly replacement, resulting in rod string wear. No maintenance or replacement has been required for these units since install.” Maintenance Co-ordinator Producer B
PRODUCER C (ROTATAP WITH WIRELESS LOAD CELL)
Install Date: June 11,2020
Producing Formation: Cardium / Rocky Mountain House region
Well Profile: Horizontal, Non-deviated well / XSPOC

Pumping unit: 320

OBSERVATIONS: Replaced traditional wired load cell with Flintec wireless load cell. Pump cards before and after install were identical. Battery life expectations were met despite extended periods of cold weather with temperatures below -30C sustained for multiple days.

ROI due to reduced load cell broken wire cable replacement costs expected to be 12 – 24 months.

SUMMARY CONCLUSIONS: RotaTap field installs occurred on vertical and horizontal wells ranging in age from 2 to 40 years, up to 14,000ft in depth and were on pump jack sizes ranging from 160's to 912's. In each case, production either increased or remained the same, but downtime and rod string adjustment frequency was markedly less frequent. In some cases, no rod string adjustments have been required since it was installed. In other cases, rod string adjustment time was halved and due to the ease of adjustment, manlifts were no longer required because a platform or ladder was deemed sufficiently safe in the absence of significant time and effort spent at height.

LOAD CELLS: Load cells dominate the market in the US, with E&P companies equipping many pump jacks with load cells and SCADA systems. The RotaTap design has a spindle that permits height adjustability and bears the weight of the rod string during rod sting adjustments. The OD of the spindle exceeds the ID of most standard wired load cells on the market. This necessitates the load cell sit above the handle of the RotaTap and spin within the confines of the bridle cables. As a result, the load cell cannot be wired and must be wireless. A number of wireless load cell solutions exist, however Silverstream decided to partner with Flintec based on their ability to adjust their design to accommodate the RotaTap dimensions and the smaller 11-12" carrier bar. Shortly after the partnership was formed, several RotaTap systems were installed with wireless load cells and the performance was proven.

Development of the wireless load cell began in 2018. In early 2019, 14 beta units were installed throughout North America, including the Eagle Ford, Permian, Bakken, California and Canada. After 8-10 months, feedback from field operators resulted in several design enhancements that provide improved operability and performance in the field - notably a separate battery compartment to improve access to the battery. The wireless technology also includes position sensing capability which eliminates additional cables and associated maintenance of hall effect sensors and/or inclinometers. Future enhancements will include rotation monitoring capabilities, as well.

The move to wireless load cells is of interest to E&P companies operating in windy areas, where cables become tangled and break at a high rate, resulting in maintenance costs and downtime to repair the broken cables. This adoption curve is aligned with the RotaTap, as we each seek early adopters who are open to new ideas to solving existing problems and improve safety related to rod string adjustments.

CONCLUSIONS:

Safety: Most other rod string adjustment processes and protocols require manual removal of the rod clamps, with elevated safety risks and time requirements. Some producers require a third party to adjust the rod string to mitigate these safety/ liability risks, this greatly increases the time and cost associated with a rod string adjustment. The RotaTap reduces safety risks, by providing a safe and easy method to adjust the rod string, without the necessity of removing the rod clamps.

Precision**:** The precise placement of the rod string relative to the rod pump is possible due to the height adjustability feature. This increases the ability to optimize rod pump performance quickly and easily, and producers have indicated this product takes a "high maintenance" well and minimizes operator (pumper) time and maintenance costs while stabilizing or improving oil production rates.

Cost Savings: The RotaTap is a premium priced product relative to the competitive products, which function solely as a rod rotator. However, the dual purpose RotaTap – which facilitates rod string adjustments while delivering superior longevity and performance despite challenging climates and well

profiles, has a positive ROI in very short period due to the increased production, reduced rod pump maintenance costs and reduced well operator (pumper) time/safety risks associated with RotaTap installations.

The elimination of wired load cells in favor of wireless load cells avoids the ongoing repair costs associated with broken cables and lost visibility on well conditions.

TABLE 1

Battery: **PIERSON 14-09-002-29W1 BT | 14-09-002-29W1 BT**
Well Description: **PIERSON UNIT #3 100/13-10-002-29W1/00 | 100131000229W100**

Pump Type: **Plunger** **Diameter: 1.5**

Test Information										Calc.	SPM/					Choke		Jts. to	Pmp Chg
Test Date	Hours	BSW %	S. Cut %	Fluid	Oil	Gas	Water	Sand	GOR	GOR	RPM	Strk L.	Eff. %	TBP	CSP	Size	JTF	Pump	Date
2017-Jan-23	24.00	7.00	0.00	9.81	9.12	2.12	0.69	0.00	0.00000	0.232	2.9	64.0	20.16	972	824I45-15A	108.0	109	2014-Nov-05	
2017-Apr-14	24.00	7.00	0.00	11.13	10.38	2.12	0.75	0.00	0.00000	0.204	2.9	64.0	22.87	972	824I45-15A	108.0	109		
2017-May-04	24.00	7.00	0.00	12.27	11.39	2.12	0.88	0.00	0.00000	0.186	2.9	64.0	25.19	972	824I45-15A	106.0	109		
2017-Jun-10	24.00	5.00	0.00	11.01	10.44	2.12	0.57	0.00	0.00000	0.203	2.9	64.0	22.61	972	824I45-15A	106.0	109		
2017-Jul-07	24.00	3.00	0.00	10.38	10.06	2.12	0.31	0.00	0.00000	0.211	2.9	64.0	21.32	972	824I45-15A	106.0	109		
2017-Aug-04	24.00	5.00	0.00	10.06	9.56	2.12	0.50	0.00	0.00000	0.222	2.9	64.0	20.67	972	824I45-15A	106.0	109		
2017-Oct-21	24.00	5.00	0.00	9.44	8.93	2.12	0.50	0.00	0.00000	0.237	2.9	64.0	19.38	972	824I45-15A	106.0	109		
2017-Dec-01	24.00	5.00	0.00	9.18	8.74	2.12	0.44	0.00	0.00000	0.243	2.9	64.0	18.86	972	824I45-15A	106.0	109		
2018-Jan-29	24.00	5.00	0.00	8.81	8.37	2.12	0.44	0.00	0.00000	0.253	2.9	64.0	18.09	972	824I45-15A	107.0	109		
2018-Mar-07	24.00	7.00	0.00	9.12	8.49	1.77	0.63	0.00	0.00000	0.208	2.9	64.0	18.73	972	824I45-15A	107.0	109		
2018-Apr-07	24.00	9.00	0.00	10.13	9.25	11.65	0.88	0.00	0.00000	1.259	2.9	64.0	20.80	972	824I45-15A	107.0	109		
2018-May-10	24.00	9.00	0.00	10.38	9.44	2.12	0.94	0.00	0.00000	0.225	2.9	64.0	21.32	972	824I45-15A	107.0	109		
2018-Jun-11	24.00	7.00	0.00	9.37	8.74	1.41	0.63	0.00	0.00000	0.161	2.9	64.0	19.25	972	824I45-15A	107.0	109		

TABLE 2

Battery: **PIERSON 14-09-002-29W1 BT | 14-09-002-29W1 BT**
Well Description: **PIERSON UNIT #3 100/13-10-002-29W1/00 | 100131000229W100**

Pump Type: **Plunger** **Diameter: 1.5**

Test Information										Calc.	SPM/					Choke		Jts. to	Pmp Chg
Test Date	Hours	BSW %	S. Cut %	Fluid	Oil	Gas	Water	Sand	GOR	GOR	RPM	Strk L.	Eff. %	TBP	CSP	Size	JTF	Pump	Date
2018-Sep-23	24.00	8.00	0.00	11.32	10.44	4.24	0.88	0.00	0.00000	0.406	2.9	64.0	23.26	972	824I45-15A	107.0	109	2018-Aug-09	
2018-Oct-30	24.00	8.00	0.00	10.32	9.50	2.47	0.82	0.00	0.00000	0.260	2.9	64.0	21.19	972	824I45-15A	107.0	109		
2018-Nov-20	24.00	8.00	0.00	9.50	8.74	2.47	0.75	0.00	0.00000	0.283	2.9	64.0	19.51	972	824I45-15A	107.0	109		
2019-May-07	24.00	8.00	0.00	18.81	17.30	2.12	1.51	0.00	0.00000	0.123	2.9	64.0	38.63	972	824I45-15A	107.0	109	2019-Apr-24	