Increasing Production by Pumping the Curve

Increase production and decrease failure rates by lowering the pump below kick off point. Due to low bottomhole pressures, setting the pump below the kick off point can increase production. However, lowering the pump below kick off point can increase failure rates due to the extreme deviation.

By utilizing TPLs which lowered the drag force by two-thirds compared to guided conventional rods, minimizing frictional losses and reducing the loads at the surface, one operator was able to achieve both goals, increasing production by 13% on average in comparison to guided rods and decreasing failures after conversion from ESP.

Higher Production Rates: Reduction in friction results in higher production rates below kickoff point, **13%** increase.

Cost Efficiency: Using thermoplastic liners instead of rod guides resulted in cost savings due to lower failure rates, reduced gearbox loading of **16%**, and reducing peak rod loading.

Longevity and Reliability: Converting from ESP to rod pump with thermoplastic liners below kickoff point has increased the mean time between failures, saving approximately **$348,000** in ESP failures since installation.

As part of the Hi-Rise System, Thermoplastic liners were installed with an operator in the West Edmond Hunton Lime Unit Field near Deer Creek, Oklahoma. The field history can be seen below.

Field Name: West Edmond Hunton Lime Unit

- Initially drilled in the 1940's before being drilled horizontally in 2005
- Field has low bottomhole pressure ~500psi
- Initially produced on ESP then converted to rod pumping after 1.5yrs
- Unable to pump at KOP efficiently

LIGHTNING PRODUCTION SERVICES™
(281) 446-8020 // INFO@LPSUS.COM // LPSUS.COM

Due to the low bottomhole pressure, it is necessary to produce these wells below kick off point from the onset. As production decreased below 200 bfpd or if a significant number of ESP failures occurred, the wells were converted from ESP to rod pump. However, when converting to rod pump, the friction created between the rods and the tubing through the curve, make it difficult to pump these wells efficiently. This operator installed LightningFlo™ 115 throughout the curve to pump the wells below kick-off point without a significant increase in failure rates. One of the wells in this case study is discussed next.

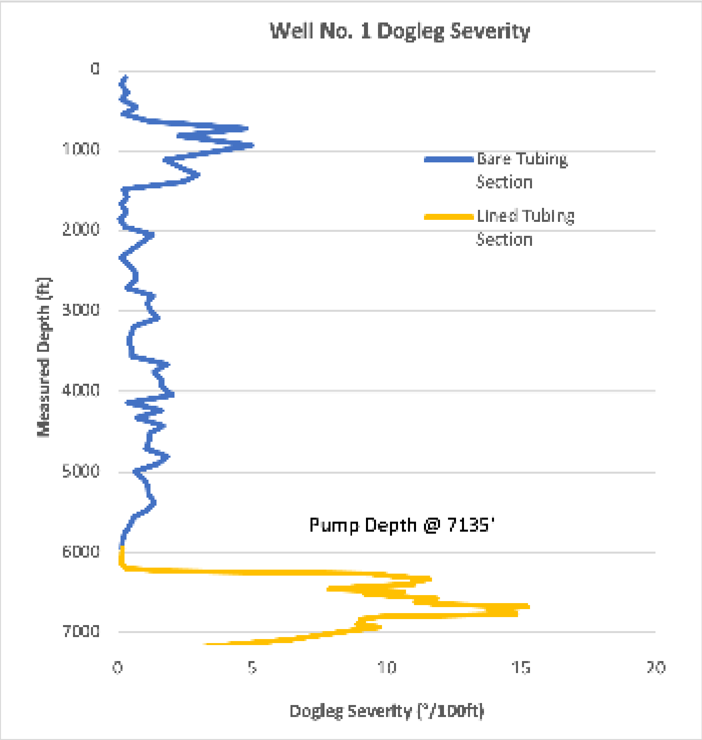

Figure 1: Dogleg Severity Graph for Well No. 1

Case Study Well No. 1

This well has the pump set at 7,135 feet with a rod string taper consisting of 2,735 feet of 1-1/4 inch fiberglass rods, 1,550 feet of 1 inch steel sucker rods, 1,050' 7/8 inch steel sucker rods, 750 feet of 1.5 inch sinker bars, and 7/8 inch steel sucker rods beneath the kickoff point and throughout the curve. This well was installed with a 1.75 inch insert pump. Thermoplastic liners measuring 1,174 feet in total length were installed below the kick-off point between 5,925 feet and 7,100 feet.

Figure 1 displays the deviation survey for Well No. 1 with blue representing the bare tubing sections and yellow representing the lined tubing section. As can be seen by Figure 1, thermoplastic liner was installed slightly above the kickoff point and continued into the lateral section of the wellbore.

When converting from ESP to rod pump, thermoplastic liners were installed in the curve section of the wellbore to prevent rod and coupling wear on the tubing. Another option is to use rod guides, which increases the friction in the overall system by absorbing the contact between the tubing and the rods. This operator reported issues with increased friction and surface requirements, as well as a higher failure rate when utilizing rod guides throughout the curve on similar wells in the West Edmond Field.

To quantify the difference between using thermoplastic liner as opposed to rod guides, two cases were calculated using a predictive program to contrast the difference in performance of the two solutions for these case study examples. Results from the comparison for Well No. 1 are displayed in Table 1.

As can be seen from Table 1, using thermoplastic liners in contrast to rod guides at similar pumping speeds, decreases the peak polished rod load and increases the minimum polished rod load. When friction is present, it can cause a shorter downhole stroke. This means less production or increasing the strokes per minute to meet targeted production. In this case, using thermoplastic liners instead of rod guides increases the downhole stroke by 18.5 inches from 139.3 to 157.8 (13% increase). The peak polished rod load (PPRL) decreased from 33,025 to 31,235 lbs and the minimum polished rod load increased from 5,218 to 5,859 lbs. Decreased PPRL and range of polished rod load benefits the power and efficiency requirements of the rod pumped system at the surface. The gearbox loading, which is overloaded in the case with rod guides at 110.7% decreases to a more acceptable operational value of 93.3% with thermoplastic liners. This is a 16% difference reduction in gearbox loading. In this case, installing thermoplastic liners instead of rod guides removes the risk of overloading the gearbox and improves operation of the system.

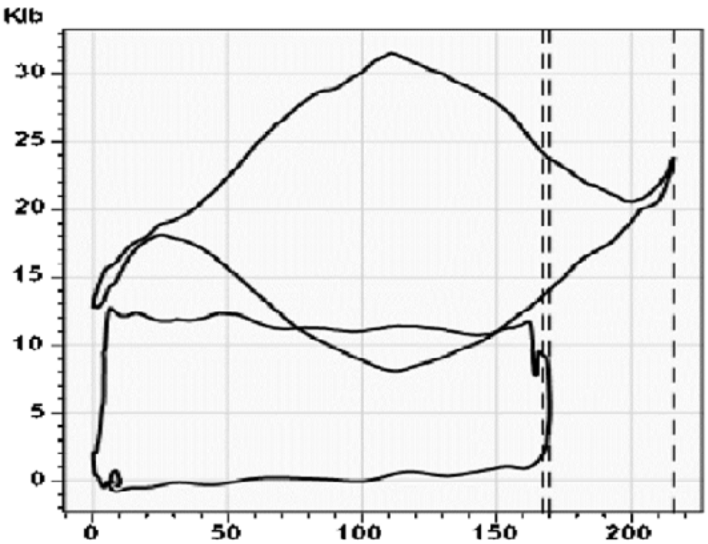

Figure 2: Well No. 1 Downhole Card

Well No. 1 Comparison: TPL vs. Rod Guides		
	Liner	Rod Guides
PPRL	31235	33025
MPRL	5859	5218
SPM	5.85	5.87
Downhole Stroke	157.8	139.3
GB Loading	93.3	110.7
PU Loading	73	77
Monthly Electric	2012	2273
Production	281	248
Peak Rod Loading	74	80

Table 1: Well No. 1 Comparison: TPL vs. Rod Guides

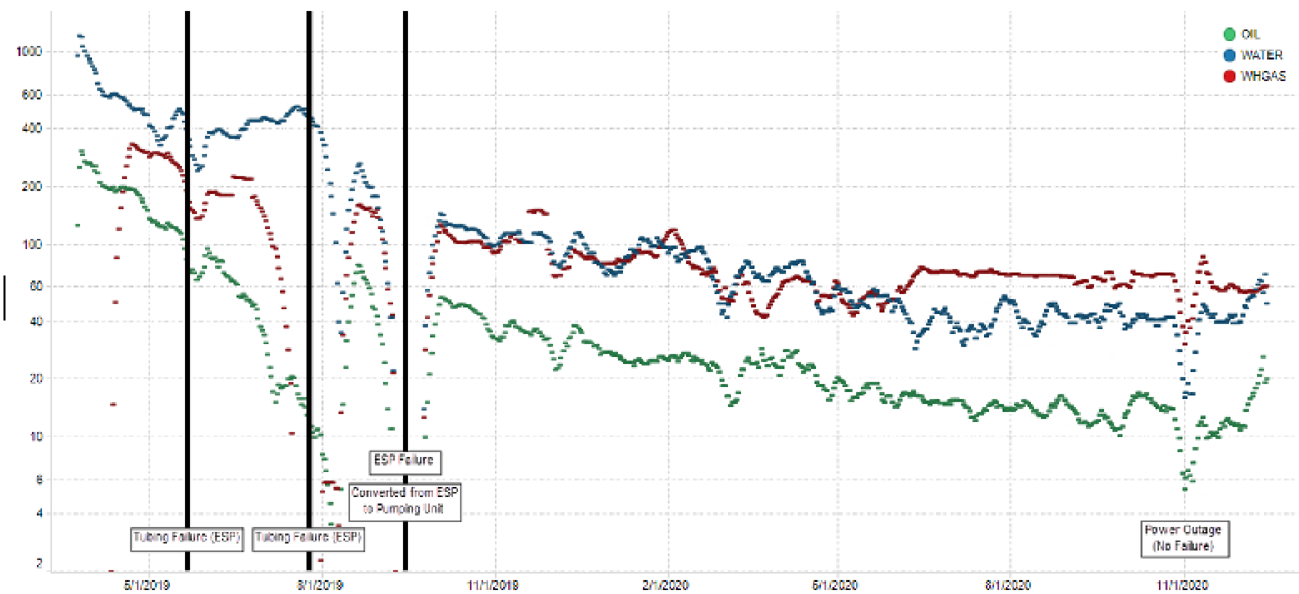

Figure 3: Production Data from Well No. 1 Prior and After Conversion from ESP to Rod Pump

Shifting from rod guides to thermoplastic liners also reduces the monthly electric cost by an estimated $261 and decreases peak rod loading from 80% to 74%.

After converting this well from ESP to rod pump with thermoplastic liners throughout the curve, this operator analyzed a dynamometer card to compare the actual load on the system compared to the predictive program.

As shown in Figure 2, the actual results of the PPRL at 31,542 lbs is close to the predicted PPRL of 31,235 lbs. Figure 3 displays the production trends before and after conversion from ESP to rod pump with thermoplastic liners throughout the curve.

As mentioned above, ESP wells were converted to rod lift when the production dropped below 200 bbls of fluid per day, however in some cases it was necessary to convert them earlier due to numerous ESP failures, as is the case of Well No. 1.

Two factors should be considered here, the steep production decline of the well and the conversion from ESP to rod pump. One would expect a drop in production when switching artificial lift methods along with a declined production curve to match the decline of the reservoir. In Figure 3, a decline in production can be seen after conversion to rod pump but appears to be more in relation to the natural decline state of the reservoir than due to the conversion to rod pump. It can be inferred from Figure 3 that for Well No. 1, the production decline matched before and after converting from ESP to rod pump.

Converting this well to rod pump with thermoplastic liners in the curve has drastically reduced the failure rate. The well has not failed to date since converting 16 months ago. Net operating revenue was nearly doubled by decreasing failure rates.

The previous failure rate for Well No. 1 prior to rod pump was 3 failures in 8 months or 4.5 failures per year. After conversion to rod pump with thermoplastic liners in the curve, there has been zero failures. The well has a current run time of over a year. The average cost of an ESP failure for this operator is $60,000, therefore this operator has saved approximately $348,000 since install.

LEARN MORE AT LPSUS.COM/HI-RISE-SYSTEM