CONTINUOUS RODS IN THE WOLFCAMP SHALE

Blake Myers
EP Energy

ABSTRACT
In today's world almost all wells in shale plays are drilled horizontally on multi well pads. The horizontal completions have proven to lead to high production rates in the early life of the well. However, production engineers are often left with highly deviated wellbores that are difficult to produce at lower rates and pressures. Historically, most companies rely on beam pump to produce in the later stages of a well's life. The deviation in the vertical or "S-shaped" wellbores often cause severe rod wear that can lead to high failure rates and costly rig time.

This paper will review the reasons EP Energy decided to switch from conventional sucker rods to continuous rods on pumping wells in the Wolfcamp Shale. Since converting there has been a reduction in rod failures, however, there have also been some unforeseen issues that have occurred. This paper will address all the operational advantages and disadvantages that have been noted and the challenges moving forward in a poor economic environment.

INTRODUCTION
The goal of this paper is to point out what has been learned by switching from conventional sucker rods to continuous rods in the Wolfcamp Shale. The intent is not to persuade you to use continuous sucker rods but simply to share some information to help you decide whether or not continuous rods might be a good solution for your wells.

Due to multi well pad drilling, engineers can be forced to design wellbores with back builds near the top of the well. There are also wells that are left crooked due to the speed or insufficient surveying while drilling. Once we started installing rod pumps in these deviated wellbores the conventional sucker rod parts quickly became an issue. Most of the failures, not surprisingly, were happening in the couplings of the rod string. After we exhausted several ideas we decided to run continuous rods in one of the more deviated holes. We experienced a much longer run time out of that well and it convinced us to look more closely at running continuous rods across the field. At that time, not only were the continuous rods comparable with conventional rods in pricing, but there were also potential operational advantages.

Over the past 18 months we have focused on installing continuous rods in all new installations and have gained a surplus of information that will be shared in this paper. Due the downturn in oil prices there are some new challenges that will be need to be addressed.

APPLICATION
The biggest benefit of using continuous rods is the removal of the pin and couplings out of the rod string. Conventional rod strings typically have a coupling every 25 feet, whereas a continuous rod string only has a connection on the top and bottom of the string. By eliminating the couplings all the concentrated contact points in the wellbore are distributed across a larger area (see Figure 1), reducing the contact load per square inch. This is particularly beneficial in deviated wellbores where there is several tubing and rod contact points. Also, because of the removal of the pins, continuous rods weigh ~8% less than sucker rods which will decrease the contact loads due to gravity.

To combat the contact points in the well, rod guides are typically used with conventional rod strings to reduce the metal to metal rubbing while pumping the well. Continuous rods don't require rod guides which gives two potential advantages to the design and performance of the well. The coefficient of friction between steel and steel varies between 0.1 and 0.2 whereas rod guides and steel can be as high as 0.31. Depending on how much deviation the well has, the friction loads can be significantly reduced by removing the guides. Another advantage is the reduction of pressure losses in the rod string. The flow area is significantly reduced when comparing semi-elliptical (SE) continuous rods to a guided sucker rod (see Figure 2). The pressure losses in the well can cause a reduction in flow rate and, in some instances, cause paraffin to form.

OPERATIONS

The continuous rod string is brought to location on a reel and gets fed into the well through an injector head on the back of the unit (see Figure 3). Rigging up to run or pull the rods is a very quick process that usually takes about 1 hour. The injector head allows the rods to be constantly run into the hole making the trip rates ~25% faster than a conventional work over rig.

The rods are sent to location with the bottom pin already welded to the string to save time. Once the string has been run in the hole the top pin must be welded on in the field. The welding process takes about 45 minutes to complete on location. The main cause for concern is the hardness of the material after welding. Although the welding technology enables the steel to get very close to the original grade, there will always be a harder material left in the heat treated zone after the welding process. If there is significant corrosion issues the welded pins will become a weak point in string. At this time it has not caused many issues in our Wolfcamp field but we are always aware of the potential issues and choose our grade of rod accordingly.

One of the big disadvantages of using continuous rods is the potential extra time and cost when a tubing pull is required. When tubing needs to be pulled, whether for repair or stuck pump, the continuous rod unit has to rig up and pull the rods, then rig down so a conventional work over rig can rig up to trip the tubing. Once the tubing is back in place the continuous rod unit has to come back and run the rods and pump in the well.

Another disadvantage is the unit availability at any given time to pull the rods. EP Energy has a dedicated unit because of the amount of business we have given over the years but that is not the case with most companies that have tested continuous rods on a few wells. Due to the lack of business in some areas it can take 2-4 weeks just to get a unit to pull rods when a failure occurs. A lot of companies end up switching back to conventional rods once they realize the increased downtime during failures when units aren't readily available. Near the Midland area, where EP Energy operates, there are now multiple companies competing for business and the unit availability has increased significantly.

ECONOMICS

Combining the trip rates with the ~10% less unit costs pulling a pump could once be done at a much lower price. Until recently, the pump pulls with continuous rods were being done ~30% cheaper than with a work over rig. However, due to the drastic change in oil prices, workover rigs are now more competitive in pricing with the continuous rod units forcing us to sharpen our pencils on the cost savings moving forward.

As mentioned above, the biggest issue with continuous rods is pulling tubing. Due to the additional rig up and rig down with the continuous rod unit, the project costs for all tubing pulls has increased by ~7%. It also has caused the production downtime to increase by ~24 hours on wells that required tubing repairs.

The difference in price between the conventional and continuous rods is negligible but the there are some obvious advantages when replacing conventional sucker rods. Normally when a continuous string has wear or corrosion you can cut that section of the rod out and weld a new piece into the string. It is good practice to limit the number of welds in the string to no more than 5, which limits the number of times you can replace a section of the rods before having to buy a new string. With conventional rods it is very easy to identify wear or corrosion and replace rods as necessary.

CONCLUSION

There is definitely an advantage to running continuous rods under the right conditions and price environments. However, it is critical to understand the wellbore conditions and unit availability when designing a well for continuous rods. It is also important to follow up with current work over rig rates and rod pricing in the area before running continuous rods.

The presentation that goes with this paper will address the failure rates and cost savings that have been seen since switching to continuous rods and in this low economic environment. It will also go into more detail about the operations and design of continuous rods.

REFERENCES

Weatherford, COROD® Continuous Rod & Flushbys, 2012

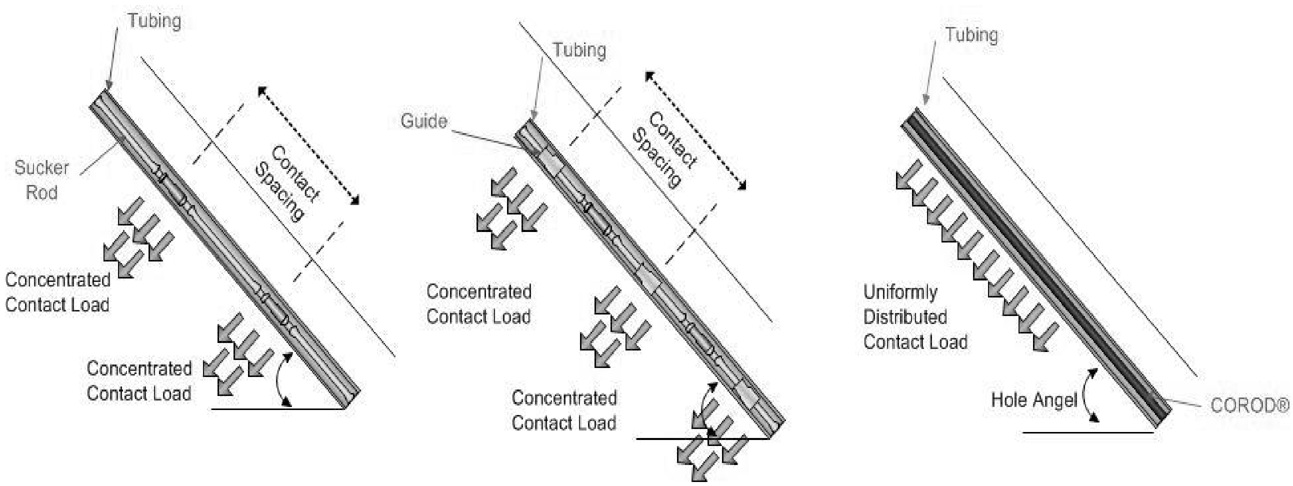

Figure 1

Figure 2

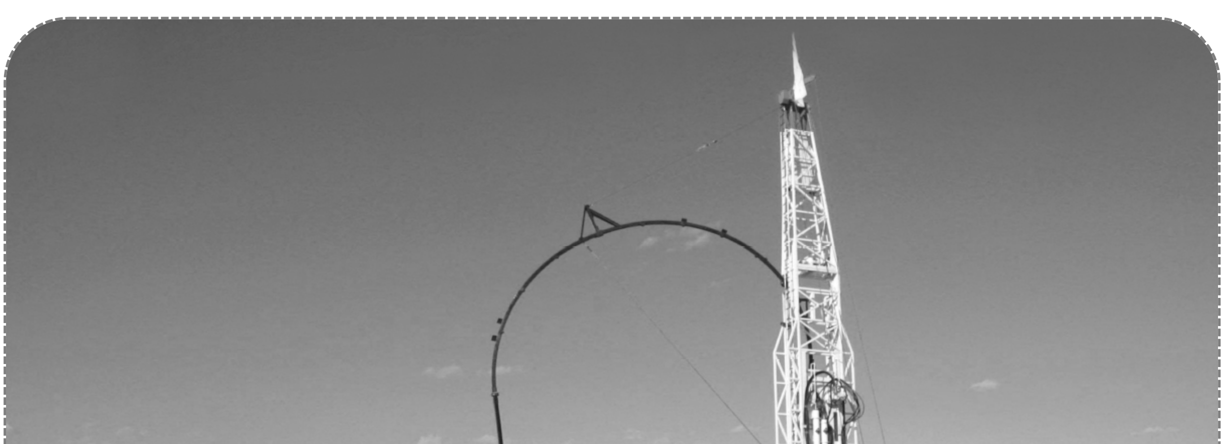

Figure 3