Plunger lift and shale well production

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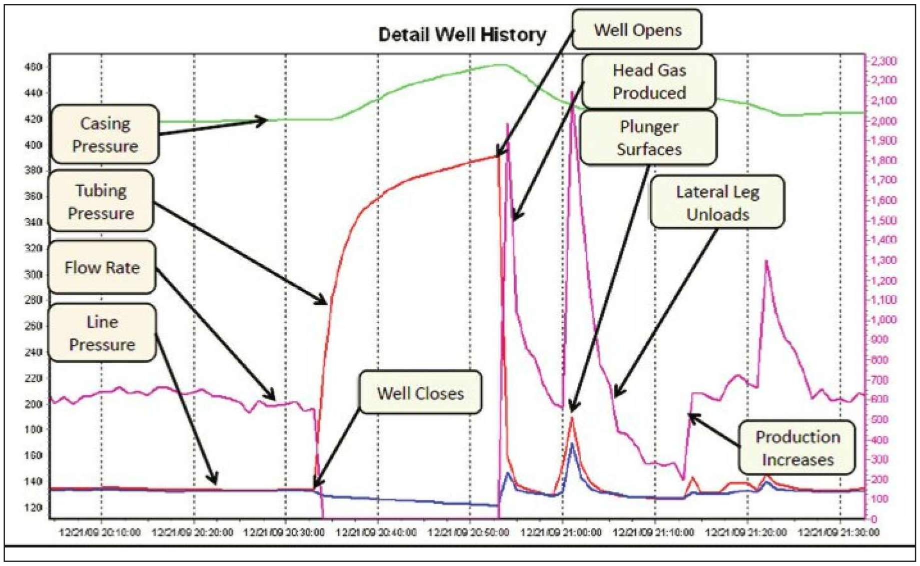
Marcellus wells, much like Barnett wells, struggle with how to move liquid from the horizontal leg to the surface. When liquid is removed from the well bore, backpressure on the formation is reduced, and gas flows freely to the surface.

Lifting devices like rod pumps and plunger lifts physically lift the fluid in the vertical leg to the surface. However, these devices are difficult, if not impossible, to set and operate in the lateral leg of a well.

In the absence of a physical device in the lateral leg to clear fluid, operators turn to a law of physics. Gas flow above a certain rate will entrain liquid in the flow stream and move it to the surface. Operators strive to ensure gas flow rates remain above critical with various forms of artificial lift, including surface compressors, gas lift devices, foaming agents and plunger lift systems.

Plunger lift is an effective form of artificial lift for horizontal shale wells. As the plunger lifts the liquid in the vertical leg to the surface, backpressure is reduced. With less backpressure, the flow rate increases, often allowing the lateral leg to unload. While the down hole flow rate remains above the critical limit (i.e., Turner/Coleman Critical Flow Rate), liquid is moved to the surface within the flow stream.

Installing plunger lift systems prior to production decline minimizes the occurrence of lost production and the potential for swabbing. For horizontal wells that recover casing pressure quickly, continuous flow plungers can significantly improve production. By making numerous cycles a day, these plungers bring small amounts of fluid to the surface on each trip. Small liquid loads require less lift pressure, thus the well production increases



by operating at a lower flowing bottom hole pressure.

Standing valves are comprised of a ball and seat, and positioned at the end of the tubing string. When the well is flowing, the flow rate pushes the ball off the seat and allows gas and liquid to enter the tubing. When the flow rate stops, the ball drops onto the seat and prevents gas and liquid from being pushed back down hole. Standing valves hold the liquid in the tubing when the well is closed, allowing the plunger to clear the liquid from the tubing when the well opens. For wells in which casing pressure and tubing pressure equalize when the well is closed, standing valves may provide significant production benefits.

For conventional plunger lift wells, the afterflow period (production phase) is typically ended when the flow rate nears the critical rate. However, for horizontal wells, closing the well too soon may result in trapping liquid moving from the horizontal leg in the vertical leg. A large volume of fluid in the vertical leg requires additional lift pressure, thus a higher flowing bottom hole pressure and less production. Flowing the well longer may clear the vertical leg and allow increased production (see graph). Using controllers that auto adjust during the plunger cycle can assist optimizing production.

Restrictions significantly reduce production. Plungers may not surface in some wells where restrictions are significant. Restrictions can take the form of small IDs in hold down assemblies, scale or paraffin in the tubing, chokes, multiple sharp tubing bends, small trim kits in motor valves and even orifice plate sizes. With 2⅜" tubing, changing from a ⅞" to 1¼" or greater orifice plate can generates positive production benefits.

Finally, downtime is the largest contributor to lost production. A shut-in 500 mcf/d well loses $15,750 per week (assuming $4.50/mcf). Ten weeks of 10-percent increased production is required to replace one week of lost production. Plunger lift systems that provide real time date, alarms, and capture relevant data for troubleshooting reduce the frequency and length of unplanned downtime. Preventative maintenance programs combined with formal problem solving techniques are well worth the effort in reducing unplanned downtime.

Plunger lift systems are an effective means of producing shale play wells. It's important to realize the differences in conventional versus unconventional wells, and use appropriate equipment and techniques.

Visit your favorite plunger lift supplier during the August 30-31 PIOGA show in Monroeville to discuss the benefits of plunger lift in Marcellus wells. ❒