TECHNOLOGY IMPROVES MARGINAL GAS WELL PRODUCTION

BOTTOM LINE

There are several approaches for profitably keeping water unloaded in marginal wells or higher volume gas wells with high liquid:gas ratios. By keeping wells unloaded, operators can maintain natural gas production, increase reserves, and extend well life.

PROBLEM ADDRESSED

As liquid loading in gas wells increases, typically from water production, the production rate decreases and, in some cases, ceases altogether. Several technologies, including plunger lift, automatic casing swab, rod pumps, soap sticks, or velocity strings, can keep liquids unloaded. Operators must know how to choose among the available technologies. Once a choice is made, it is just as important for an operator to know how to optimally apply the technology to maximize production efficiency.

KEY WORDS:
Marginal Gas Wells
Plunger Lift
Automatic Casing Swab
Downhole Injection
Liquid Unloading

TECHNOLOGY OVERVIEW

Rod pumps, periodic blow downs, and swabbing are some of the common approaches for unloading water that restricts (or stops) production in gas wells. However, they each have drawbacks. Rod pumps can be expensive to operate and maintain. Blowing down wells wastes natural gas, as does swabbing. Swabbing also can be costly, and production often is lost when wells are not promptly swabbed.

Two other approaches, plunger lifts and casing swabs, can be profitable alternatives. Plunger lifts operate in tubing, lifting fluids by velocity. In contrast, automated casing swab (ACS) systems, which function in casing, lift fluids using pressure, instead of velocity. They require less pressure and natural gas volumes to operate. For higher water volumes, subsurface injection may be an option.

For the typical gas well producing through tubing with the casing shut-in, the shut-in casing pressure should be only slightly higher, accounting only for friction losses in the tubing. When wells are loading up, the casing pressure will be much higher. Plugged or crimped tubing also causes high differential pressures. If the pressures are the same, leaks are the likely cause.

Plunger Lift. The plunger seal and velocity are key considerations for plunger-lift systems. Brush-type plungers have the best seal, while bar stock plungers have the worst. Plunger velocity should range from 600 to 900 feet per minute (fpm). Below 600 fpm, stalling may occur. Above 900 fpm, wells will not produce at maximum rates and the higher speeds can be hard on equipment. Automatically controlled plunger systems measure travel time and make adjustments, reducing the amount of operator time required to line out a system and optimize run time.

When installing a plunger lift system, operators should check for damaged tubing with wireline gauge ring runs, and examine wellhead components for variations in the internal diameter. The tubing should be set somewhere between the middle and top of the perforations. For automatic controllers, operators must provide initial settings for travel time windows, incremental changes, and initial shut-in and afterflow periods. For maximum production, operators should strive to produce the well at the lowest possible casing pressure with the highest frequency of plunger trips. To maintain efficiency, the lubricating springs should be inspected regularly, and the plungers should be replaced every six to 12 months.

Successful plunger lift systems depend on proper candidate identification, good wellbore mechanical

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integrity, and the lease operator. Of these factors, Conoco's experience with over 200 plunger lift systems in the San Juan Basin shows that the lease operator's understanding of basic operation was the single most important factor.

Automatic casing swab. Forming a positive seal with the casing, an ACS system requires only minimal pressure to lift fluids to the surface. A surface lubricator opens when the ACS reaches the surface. When going back in, a stop limits downward travel. Since a positive seal is formed, fluids are maintained above the ACS, even if sales cease or line pressure increases. Since only 6 psi are required to lift the ACS, the system can operate at pressures lower than those used by plunger lift systems.

ACS cycle times may vary from four hours to one week, with normal cycles recovering 1 to 3 barrels of fluid. Wells with low gas:liquid ratios may operate too slowly. A rule of thumb is that 3 to 5 thousand cubic feet (mcf) per barrel total fluid is required. Production casing must be of uniform weight, in good condition, and clear of scale, paraffin, or salt buildups. When an ACS is installed, the casing should be scraped to a level below the downhole stop.

For wells with sudden or unexplained production declines, ACS systems may resolve the problem. Even if a well had not experienced abnormal declines, an ACS system can lower operating costs. Following conversion, an ACS well may produce slightly greater fluid volumes, but gas:liquid ratios will normally return to the original ratio within a short period of time. Operators should consider ACS systems for new wells, since equipment and installation costs will be lower and the well would produce at maximum capacity from the start.

Earlier ACS systems were unreliable, mainly due to cup or seal sizing, cup stretching and swelling, mechanical tool problems, or poor casing conditions. Sandia National Laboratories, working with Belden & Blake Corp. in a US Department of Energy project, under the Natural Gas and Oil Technology Partnership, has applied advanced technology to improve system reliability.

Downhole Injection Tool. For larger water volumes, downhole disposal may be a viable option. Downhole Injection, Inc. has developed tools that can dispose of water either above or below the producing zone. For wells that can dispose below the producing zone, a multi-well injection tool can help operators dispose of moderate amounts of water from nearby wells.

The tool is used with standard rod-pumping units, connected at the base of a modified tubing-type pump. In the injection process, it becomes both the traveling and standing valve. On the upstroke, the pump draws annular fluid into the barrel. On the downstroke, the intake valves close, discharging fluid through the back-pressure valve and packer into the injection zone under pressure. The pump-bore size, stroke length, and strokes per minute are set to match water inflow rates from the producing zone with the amount to be injected. Downhole injection requires less peak torque and horsepower, as the required power is not related to the amount of water injected.

Candidate wells must have a disposal zone with adequate injectivity and appropriate geological barriers. Typically, the well should be cased at the intended injection zone. A sufficient depth interval is needed between the injection and the producing zones to allow proper water-gas separation. Operators should contact appropriate regulatory bodies since injection well permits are usually required.

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