GAS WELL DELIQUIFICATION OPTIONS FOR THE MARCELLUS SHALE
September 25, 2008; Morgantown, WV

BOTTOM LINE

Removing liquids from producing wells is important to retaining domestic production and preventing premature abandonment of oil and gas wells. Although a small percentage of total well cost, the cumulative lifting costs in the US each year are not insignificant, and improved efficiency and reduced cost are achievable goals. Numerous options are currently available to operators, who should be able to match their particular situation with the most efficient and cost-effective option.

PROBLEMS ADDRESSED

Steve Turk opened the workshop with a broad overview of energy and the world, and the need for continued advances in technology to meet the demand for energy in a cost-effective manner.

From 1970 to 2006, energy producers around the world produced less oil than their capacity to produce, i.e., world demand was met, but was not exceeded by, production. Thus, curves for "capacity to produce" and actual production were separated by a gap that represented world excess capacity. However, in 2006 the curves intersected, such that demand now equaled production, which in turn equaled the ability of the world to produce. The inevitable result: high oil prices.

At the same time, discovery rates were decreasing, and discoveries that were made were generally smaller than in the past.

Currently in the US, rig counts are up after a flat year, and the expectation is that we will see a 20% increase in 2009. Permits are up, so operators now find themselves at the mercy of plants that can manufacture new rigs.

Drilling and production nationwide is focused on numerous very active shale plays, deep water plays, CO2 enhanced oil and gas recovery, and other non-traditional plays that require higher oil prices to offset the cost of drilling in deep water, high fluid lifting costs, and increased completion costs.

2008 drilling costs in the US are about $413/ft for gas wells, and $450/ft for oil wells. Projections for 2009 are in the range of $446/ft and $487/ft for gas and oil wells, respectively.

Total costs to drill, complete and produce wells in the US in 1999 were $75 billion; in 2008, these same costs for all services are expected to reach $260 billion, a very large increase in domestic investment. Artificial lift costs are about $6 billion of this total.

Steve Turk posed this question: What do you want from artificial lift services? Maximum oil production? Reduced failures? Increased efficiency? Lower energy consumption? Of these, which is the most important?

All of the above are tied together, so the one-day course presented an elimination process that was easy to follow, yet detailed in content and application. In essence, operators were given screening criteria to be used to match their needs to the appropriate artificial lift system.

TECHNOLOGY OVERVIEW

A variety of lift systems was covered during the day, including progressive cavity pumping systems, reciprocating rod lift systems, electric submersible pumps, hydraulic lift systems, gas lift systems, plunger lift systems, capillary lift systems and new technology.

Progressive cavity pumping (PCP) systems were designed to handle solids with gas, making the system idea for coal bed methane wells, in which coal fines can tear up rods and pumps. This system also can be used in a horizontal leg, if the curve was built slowly (less than 15 degrees per 100 ft). The problem is in separating liquids and gas in the legs, so this system is not used in the Barnett play. Depth of use is determined by temperature as well as by lift capability.

Currently, there are about 40,000 PCP's worldwide, of which about half are in use in Canada and 5000 in the US. The two main US uses are in CBM plays and heavy oil fields.

Reciprocating Rod Lift systems have been applied to horizontal wells in the Marcellus play, but with poor results. In the Barnett play, these pumps failed after about 10 weeks due to fines infiltrating the pumps. Therefore, this system is not recommended for the horizontal leg, but is adequate for the vertical portion of the well, and in the bend up to 40 degrees, because the system can remove fluids that create a hydraulic head and pressure on the formation.

Electric submersible pumping systems are not recommended for horizontal shale wells.

Hydraulic jet lift pumping systems inject fluids at variable pressures and rates, depending on nozzle to throat ratios. Jet pumps always work, but at lower efficiencies. However, they are cost effective.

Hydraulic piston lift systems can be used in deep wells (15,000 ft) and in deviated wells, but require specific bottom hole assemblies, surface facilities and a high-pressure surface line.

Gas lift systems can be applied in wells where pressurized injection gas is available, wells with insufficient bottom hole pressure, or deep wells that cannot flow against a hydrostatic head. They also are used to increase production in naturally flowing oil and gas wells. They may not be economical in one-well leases. Options exist, including with or without a packer; annular flow; plunger assist; and "xtra-lift" system, in which gas is lifted into long perforated intervals.

Plunger lift systems use a well's own energy to lift liquids. They can be used to dewater gas wells, and to keep wells free of solid deposits, such as scale, paraffin and salt. This is the lowest cost artificial lift method, and can be used to produce a well to depletion. This system also can be used at great depths, up to 19,000 ft, although 8000 ft is a typical application. This system is good in deviated wells.

Near the end of the workshop, the instructor led the group through Weatherford's unloading selector tool. Three examples were presented. In each, the variables were discussed, real data were presented, and the proper lift system was chosen by going through the selection process.

The workshop ended with a list system installation and operating cost analysis.

CONNECTIONS

The above observations were based on a workshop sponsored by PTTC's Appalachian Region in Morgantown, WV on September 25, 2008.

Weatherford International, Incorporated's Artificial Lift System Division provided three speakers for the workshop: Darwin Trahern, Toby Pugh and Steve Turk. Their message to the group was, "Weatherford is coming into this area, and is here to stay."

Speakers:

Darwin Trahern, Weatherford International, Inc Artificial Lift Division, 4017 Washington Road, McMurray, PA 15317-2520; phone 817-319-5200, e-mail Darwin.trahern@weatherford.com

Toby Pugh, Weatherford International, Inc Artificial Lift Division, Denver, CO; toby.pugh@weatherford.com

Steve Turk, Weatherford International, Inc Artificial Lift Division, 15710 JFK Blvd, Suite 700, Houston, TX 77032; phone 281-260-1976, e-mail steve.turk@weatherford.com

SUMMARY OF EVALUATION FORMS

Twenty eight people attended the course, which originally was scheduled to be offered two days, the 24th and 25th. However, because only four people registered for the course on the 24th, these four were asked if they could attend on the 25th. They obliged us, so the course on the 24th was canceled.

Of the 28 who attended, 17 filled out an evaluation sheet. Sixteen of these worked for an oil or gas company; one was a consultant. Fourteen of these registrants received an e-mail with course announcement attached; the other three learned of the workshop through other means.

Most of those who submitted a form (15) felt that the program met their expectations, although twice as many circled a four as those who gave a maximum score of 5 for this criterion. Two appeared not to have been impressed with the course.

All felt the speakers and facilities were acceptable, and all but one felt that the course was well organized. Comments received suggested that Weatherford did a good job, and should be invited back to give additional courses on other areas, such as fishing operations on gas wells. Other comments, however, were that the topics covered do not include the type of production methods used in this basin, and that more on soap and plungers would have been beneficial.

Additional topics that were suggested for future workshops included fracturing fluids, gas lift, jet pumps, fishing tools, packer assemblies; something more specific on the Marcellus Shale; reserve estimates and decline curve analysis; well completions, from drilling to flowback; and more detail on the contents of this course.

ATTENDANCE

Attendance list

1	Baxter	Gary	Day 2 Lift	Operations Engineer	Equitable Production Company
2	Botterman	Robert	Day 2 Lift	Geologist	Sylvan Energy
3	Fry	Doug	Day 2 Lift	Plugging and Abandonment	Equitable Production Company
4	Gum	Robert	Day 2 Lift	Lead Asst. Supt. Production	Equitable Production Company
5	Heinrich	Carl	Day 2 Lift	Geology Manager	Condevco
6	Hines	Time	Day 2 Lift	Lead Asst. Supt. Production	Equitable Production Company
7	Jackson	Joshua	Day 2 Lift	Engineer	Equitable Production Company

8	Kendziora	Anthony	Day 2 Lift	Production Foreman	CNX Gas
9	Mast	Jeff	Day 2 Lift	Engineer	Equitable Production Company
10	McClaughlin	Sam	Day 2 Lift	Production Foreman	CNX Gas
11	Meade	Clint	Day 2 Lift	Lead Asst. Supt. Production	Equitable Production Company
12	Nance	Steven	Day 2 Lift	President	Natural Energy Development Corp
13	Necessary	Russell	Day 2 Lift	Production Foreman	CNX Gas
14	Reardon	Richard V.	Day 2 Lift	G.M.	Boyd & Shriver, Inc.
15	Rechkemer	Dan	Day 2 Lift	Production Engineer	Equitable Production Company
16	Rothenbuler	Kevin	Day 2 Lift	Drilling Engineer	Petroleum Development Corporation
17	Smith	David J.	Day 2 Lift	VP	Natural Energy Development Corp
18	Stumbo	Joey	Day 2 Lift	Lead Asst. Supt. Production	Equitable Production Company
19	Thomas	Arnold	Day 2 Lift	Operations Engineer	Equitable Production Company
20	Vandyke	Alan	Day 2 Lift	Production Foreman	CNX Gas
21	Veigel	William	Day 2 Lift	Production Engineer	Exco- North Coast Energy
22	Bucher	Jacob	Day 1 log, Day 2 Lift	Field Supervisor	Bucher Exploration LLC
23	Harpold	Kurt	Day 1 log, Day 2 Lift	Sr. Technical Professional	Halliburton
24	Hilvers	George	Day 1 Log, Day 2 Lift	Consultant	GH Services LLC
25	King	Michael	Day 1 Log, Day 2 Lift	Drilling/Prod. Manager	R.H. Adkins Companies
26	Schafer	Donovan	Day 1 log, Day 2 Lift	Petroleum Engineer	Energy Corporation of America (ECA)
27	Waits	Derek	Day 1 log, Day 2 Lift	Production Engineer	Petroleum Development Corporation
28	Ward	Jim	Day 1 Log, Day 2 Lift	Geologist	Red Resources