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Artificial Lift Tech Continues Evolving

By Corinne Westeman

The science of artificial lift has evolved dramatically, driven by operational challenges ranging from high-pressure/high-temperature deepwater oil reservoirs to liquids loading in natural gas wells producing below the critical rates and pressures needed to keep wellbores unloaded.

Arguably the biggest step changes in artificial lift technology, however, are being driven by the proliferation of horizontal wells in onshore resource plays, with their characteristic multiphase flow regimes and steep decline curves, according to Lloyd Heinze, a professor of petroleum engineering at Texas Tech University and executive director of the Southwestern Petroleum Short Course.

While more than 95 percent of all U.S. oil wells require some form of artificial lift (as do increasing numbers of gas wells), Heinze says future advances will revolve around two key challenges:

- Lifting the full liquid contents of long horizontal well sections as operators continue to extend lateral lengths; and
- Separating water down hole so that it does not have to be lifted to surface and then either disposed of or treated and recycled.

"The growth of horizontal wells in multiwell pads in liquids-rich shale plays already is, and likely will continue to be, the driving force of innovations in the artificial lift sector," he states. "Sucker rod pumping is limited in horizontal wells, and both jet pumps and electric submersible pumps can be limited in these applications as well."

Because of the limitations of the various types of pump systems, operators in many plays implement multiple forms of artificial lift at different points in a well's production cycle. For example, Heinze notes, in Permian Basin tight oil plays such as the Wolfcamp, a well may be equipped initially with a jet pump or ESP to accommodate high flush rates, but then be converted to gas lift after a few months, and then to beam pumping after that, when production has declined to an optimal level for rod pumping.

ITT Interconnect and its BIW Connector Systems brand launches its Metal-Lok™ Ultra HP/HT wellhead penetrator system with k-PaC™ Technology, which allows electrical power to pass safely and reliably to submerged pumps. The system is capable of withstanding temperatures to 500 degrees and pressures of 3,000 psi.

"Artificial lift companies and operators will have to work together to figure out technologies that can pump the horizontal sections of the well faster and more effectively," Heinze comments.

Downhole Separation

Similar in theory to solutions for downhole gas/liquids separation, but more complex in practice, economic downhole oil/water separation (DOWS) has long been a key objective for both operating companies and equipment manufacturers. There have been applications of different DOWS configurations in North America, but the technology remains a moving target.

The idea, according to Heinze, is to separate water from oil using an in-well hydrocylone or gravity separation device, and then pump the oil to surface while directing the water within the same wellbore to an injection zone either above or below the productive zone.

"Treating and disposing produced and flowback water represents a significant cost for operators, especially in shale plays," Heinze says. "Effective downhole oil/water separation would greatly reduce the cost associated with handling water in these plays, and also might allow additional oil to be recovered, helping increase estimated ultimate recoveries in low-permeability unconventional formations."

In the meantime, oil and gas companies' quest to improve asset performance, boost production economics, and maximize EURs is sparking innovations across all types of artificial lift technology.

Penetrators, Splices

ESP lift systems–especially their safety barrier penetrator components–

have to become more reliable to meet the industry's ever-evolving needs, contends John Hirsekorn, director of engineering for oil and gas products at ITT Interconnect Solutions.

"Operators want systems that will last," Hirsekorn remarks. "You need components that can handle higher pressures and temperatures. If production operations have to stop to replace downhole components, the producer loses money and production. Longevity and reliability are crucial to the success of any ESP installation."

Noting that failures in ESP applications–particularly those in harsher downhole conditions–often are related to the cabling connecting the power source with the ESP, Hirsekorn announces that ITT's BIW brand has introduced the k-PaC™ Technology, a cable termination capable of withstanding temperatures to 500 degrees F and pressures of 20,000 psi. The system allows electrical power to pass safely and reliably to submerged pumps through the well pressure barriers, he says.

"The key is the patented sealing mechanism and pressure-balancing technology that eliminates many of the failure mechanisms found in traditional sealing systems," Hirsekorn details. "This way, it is applicable in any environment. It does not wear as fast from downhole conditions, and eliminates the need to frequently pull and replace damaged ESP strings."

According to Hirsekorn, the k-PaC Technology is employed in the new Metal-Lok Ultra wellhead penetrator system, and is ideal for high-temperature applications such as steam-assisted gravity drainage, but is applicable to almost any well type or reservoir setting. He notes that an operator is testing the technology in a very harsh downhole environment in Canada. While systems previously have lasted only a few months, the new system has been down hole for more than eight months without incident, he reports.

"In fact, when we had to pull up the pump because another part had broken, the Metal-Lok components looked brand new," Hirsekorn states.

ITT BIW also has released a new line of Presta™ mechanical splices for ESPs in deepwater and extreme service wells, which also use k-PaC Technology. Hirsekorn says the splices offer longer lifetimes, are faster to assemble, accommodate different-sized cables on either end, require no special expertise to install, and can handle high-pressure fluid columns and long work cycles as well as the repetitive pressure cycling conditions prevalent in deepwater production.

"A good ESP system can save millions of dollars because a deepwater rig mobilized to work over an ESP well can cost $300,000-$400,000 a day," he reasons. "More reliable, longer-lasting splices help operators improve ESP run times and reduce downtime and cost."

The splices are engineered to tolerate pressures in excess of 15,000 psi and temperatures to 400 degrees, as well as the high downhole gas concentrations often experienced below the packer, according to Hirsekorn. ❒