

Sliding Vane Pumps

Overcome Gas Pressure Variation in the Bakken

By DOUG CUMPSTON / Blackmer

In late 2014, the United States became the world's leading producer of natural gas. The ongoing boom in domestic oil and natural gas production—which is being driven largely by historic recovery rates in the nation's shale plays, particularly the Bakken in North Dakota—has forced a change in the way the industry is being perceived.

This change in perception not only pertains to the noteworthy amounts of oil and natural gas that are being produced, but how and where they are being recovered. This perception is also influenced by the makeup of commodities and how that affects their handling, transport, storage and refining.

“It's a left-brain, right-brain type of situation,” said Tom Roberts, field supervisor for Pelican Gathering Systems, LLC, in New Town, North Dakota. Pelican is a subsidiary of Slawson Exploration Company, Inc., Wichita, Kansas.

“What they're doing up there in the Bakken in North Dakota is on a bigger scale than what I've seen before, because what they do is have six to eight wellbores on one site with huge tank batteries. One site might pump 2,000 to 2,500 barrels off-site because of so many wellbores. It's an entirely different way of doing things.”

Roberts is an expert on transportation in the oilfield. For the 15 years before he joined Pelican, he worked on a 500-mile, 16-inch pipeline system that bisected New Mexico from northwest to southeast and into Texas. In that case, the commodity being transported was traditional West Texas Intermediate crude oil. Since moving north, he has discovered that Bakken crude is an entirely different animal. Specifically, it can be defined as a three-phase liquid in that it is of a

light viscosity with a high concentration of entrained natural gas and other components that affect its specific gravity from day to day.

Banking On The Bakken

Slawson Exploration is a privately held oil-and-gas exploration company that was founded in 1957 by Donald C. Slawson. Since its inception, it has drilled more than 3,500 wells in 10 states. Its current exploration and production operations in the Bakken are centered near New Town, North Dakota, which is near Lake Sakakawea, 70 miles east of Williston and 140 miles northwest of Bismarck.

Once Slawson's Bakken oil and natural gas are produced, they are transferred from the wellhead into a Pelican pipeline system, which moves the commodities to one of four delivery



Image 1. These pumps can handle the harsh operating conditions found in the Bakken, where temperatures can reach -50 F. (Images courtesy of Blackmer)

points: a pair of rail terminals near New Town or two connection points with other pipeline companies.

Since initiating its Bakken operations in late 2012, Slawson has produced more than 10 million barrels of Bakken crude oil, with 930,000 barrels alone recovered in January 2015.

To transport the produced products, Pelican uses polyethylene pipeline that has a maximum working pressure of 125 pounds per square inch (psi).

Once the commodities reach the pump stations, however, steel pipe with a rating of 600 psi is used to move them into storage tanks, with 6,400 to 12,800 barrels of storage space located on-site. From the storage tanks, they are eventually transferred to railcars that take them to the next link in the supply chain.

Critical to the effective operation of this transport, delivery, transfer and storage system are the pumps that introduce the oil and natural gas into the pipeline at the wellhead, transfer it through a series of switching stations located along the pipeline and then deliver it to the storage tanks.



Image 2. Since initiating its Bakken operations in late 2012, Pelican Gathering Systems has produced more than 10 million barrels of crude oil. Critical to the effective operation of the company's transport, delivery, transfer and storage system is the pumping equipment.

"The pipeline itself has a 125-pound working limit and some of the pipe runs are quite long with many laterals, so pressure consistency is very important to keep well production at its optimum," said Mark Williams, corporate account manager for Farmington, New Mexico-based Horizon Power Systems, a designer, fabricator and servicer of oilfield production equipment and systems. "The inlet pressure to the pipes can vary a lot according to the tank-battery level and how much gas is

entrained in the oil. This can result in vapor-lock conditions if the pump is not able to work through upset conditions."

Slawson was using one brand of gear pumps in these critical applications, but Roberts noticed that their operation was compromised when the vapor pressures varied too much, which hampered the overall efficiency of the pipeline operation.

"The thing about the gear pumps is they are more particular when talking about vapor pressure; they need the right head pressure to keep a constant flow," he said. "I had a lot of calls from the field where my guys were saying that the pump's vapor-locked and there are still five feet of product in the tank."

The Perfect Pumps For The Process

In the search for a solution, Roberts reached out to Williams and Horizon Power Systems. "Tom asked me what I thought was the best pump to handle an oil that had a lot of entrained gas and also had a very low viscosity, and, after doing some research, we decided on an ideal brand and developed a package that Slawson wanted," Williams said.

Specifically, Williams recommended pumps that are ideal for handling high vapor pressure petroleum products. Their operational features include



Image 3. As part of his responsibilities, Tom Roberts, field supervisor for Pelican Gathering Systems, monitors the Pelican pipeline system, which uses pumps to introduce the oil and natural gas into the pipeline at the wellhead, transfer it through a series of switching locations along the pipeline and then deliver it to the storage tanks.

sliding-vane design that self-adjusts for wear to maintain flow rates; self-priming and dry-run capabilities; adjustable relief valve that protects against changing and excessive pressures; and easy vane replacement and maintenance that does not require the pump to be removed from the piping system.

“One of the other advantages of the pumps, in this case, is that they have had the experience in pumping high-pressure liquids like propane and butane,” Williams said. “The vane-type pump is very kind to the fluid, and it doesn’t break out the gases from the liquids as badly as a gear pump or centrifugal pump would.”

Slawson is using three sizes of these pumps—1.5-, 2- and 3-inch or, in Slawson’s vernacular, 1, 2 and 5 barrels-per-minute (bpm) models—with the pump, motor and gear case installed on a skid that has the suction and discharge piping terminated at the edge. The skid is also outfitted with all necessary valves, instrumentation and caps. The skids are then installed at the tank batteries. Currently, Slawson is utilizing 60 to 70 skid-mounted units that are outfitted with the pumps.

“Not only do you not really have any vapor issues, but the ease of maintenance and repair is pretty remarkable, in my opinion,” Roberts said.

“We took two or three guys and made them repairmen on these pumps, and they can go service these pumps everyday. We’re running them really hard so they need routine maintenance for bearings and things like that, and in less than two years those guys were able to take a rebuild kit and call two hours later and say, ‘You’re ready to go.’ That’s a big advantage compared with having another brand of pump that made it necessary that I call somebody from another distributor and wait for the technician to drive two hours from



Image 4. The rare characteristics of Bakken-produced crude oil create the need to identify pumping technologies that can work in unison with its various properties, including high levels of entrained gases and low viscosity.

Bismarck to come fix the pumps. The downtime on these pumps is pretty small; we can fix something that is completely down and be back up and running in less than two hours.”

These pumps can also handle the harsh operating conditions found in the Bakken, where temperatures can reach -50 F (-46 C). Their methods of construction and operation and their use of mechanical seals also eliminate product leaks that could potentially foul the environment, which is a constant concern for oilfield operators.

“We take a lot of care that the pumps are properly vented on their skids so that they don’t make a mess and will continue to lower the environmental impact,” Williams said. “When we built our skids with the pumps, we took a lot of care to make sure that any environmental impact was as controllable as possible.”

The positive impact of the new pumps has been so pronounced that Roberts is contemplating taking the 30 or so skids that still feature gear pumps and switching them over.

“That’s one thing I can compare performance-wise—how the pumps

perform in relation to something else,” Roberts said. “As we look at what we can do better, that would be one of the things, picking off those gear pumps. If we have a gear pump on its last legs, sure they can be rebuilt, but more frequently you just replace the pump.”

Conclusion

The historic leap in U.S. oil and natural gas production has necessitated not only a new way of viewing the industry but a new way of attacking its challenges. The rare characteristics of Bakken shale crude oil have created the need to identify pumping technologies that can work in unison with the product’s various levels of entrained gases and low viscosity.

After years of working to find the right solution, Slawson Exploration and Pelican Gathering Systems have found the best pumping technology for their pipeline applications. ■

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