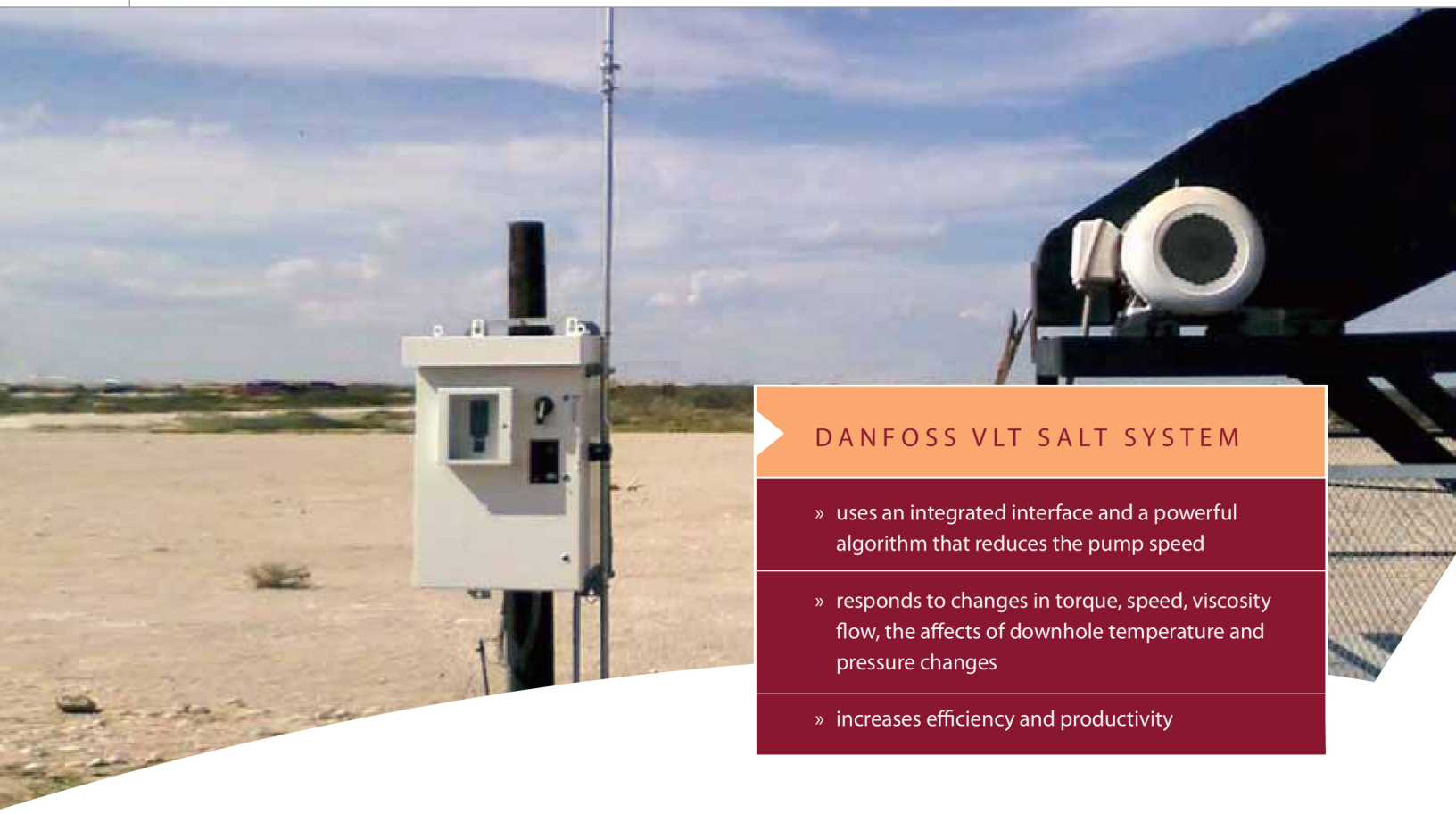


DANFOSS VLT SALT SYSTEM

- » uses an integrated interface and a powerful algorithm that reduces the pump speed
- » responds to changes in torque, speed, viscosity flow, the affects of downhole temperature and pressure changes
- » increases efficiency and productivity

DANFOSS SALT PUMP TECHNOLOGY

Improves Reliability & Efficiency for Oil and Gas Producers

AT A TIME WHEN OIL AND GAS WELLS are making headlines, it's reassuring to know that an advanced variable-frequency drive (VFD) pump solution from Danfoss is making oil and gas production more efficient and reliable.

To anyone driving in the western U.S. and Canada, beam or rod-lift pumps are a familiar sight—with their unmistakable horse-head weights, counter-weights, and rods rocking up and down on the horizon. The pumps are a necessity of life for hydrocarbon producers, because inside most established wells the pressure is too weak to lift the crude oil to the surface. Even when the pressure is high enough to bring fluids to the surface naturally, pump technologies known as "artificial lifts" are used to boost production.

Efficient production is critical to David Ellis of Noble Energy. This independent, Houston, Texas-based energy company is engaged in worldwide oil and gas production and prides itself on innovation. Ellis was happy to hear that Danfoss had an innovative idea that could improve the productivity for the artificial lifts used in his Oklahoma fields.

"We're interested in anything that produces more oil using less electricity," says Ellis. "Plus, anything that keeps our equipment running longer and more reliably is an idea we'll consider."

Ellis heard about the Danfoss solution from his distributor, Randy Butler from Wilson, an industry leading provider of pipe, valve and valve automation, fittings, and artificial lift systems.

"We supply a lot of equipment to Noble Energy," says Butler. "So we know what works and doesn't work when it comes to increasing production and reducing mechanical failures."

He knew Ellis would be interested in the Danfoss VLT® Sensorless Artificial Lift Technology (SALT).

"The efficiency of an artificial lift is a factor of the volume of oil that it actually pumps divided by the volume it can theoretically pump," says Butler. "But in most artificial lift systems, you don't come close to the theoretical efficiency. That's because as the pump reduces the fluid level, the pump-off controller shuts the unit down. You don't want the pump running when fluids are low. Otherwise, shock loads, known as 'fluid pound,' will damage the rod string. And when shutdown occurs, the pump stays off until fluid builds up in the well bore. Then you can restart the pump. But that on-off cycle hurts productivity. Plus it consumes a lot of electricity to restart the motor and get those heavy weights back in motion."

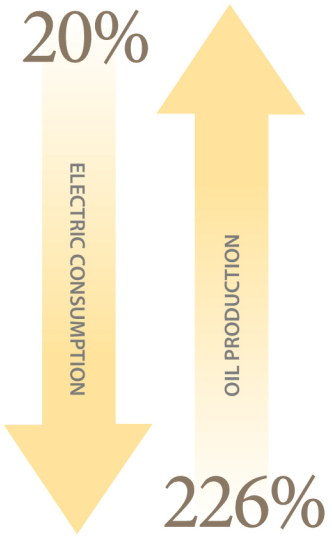
The typical beam pump is driven by an electric motor with fixed frequency and voltage—so they are either on or off. To avoid starts and stops, variable-frequency-drive solutions (VFD) are sometimes applied to slow the pump down to match the well's low productivity. But most VFDs have to be configured in a panel with an interface and pump-off controller board connected to an array of pressure and temperature sensors—a complex approach that still doesn't respond adequately to pump conditions.

Butler realized Danfoss had a better solution. The Danfoss VLT SALT drive is designed specifically for oil field applications. Unlike standard pump-off controllers, SALT uses an integrated interface and a powerful algorithm that reduces the pump speed, maintaining and maximizing production while reducing energy consumption and mechanical stress. The VLT SALT system also provides warnings for pump off, paraffin buildup, gas pockets and other serious conditions.

"The VLT SALT controller does not normally stop the pump—it slows it down until the fluid levels have recovered," notes Ellis. "Because we can avoid the heavy amperage draw during restarts, we've been able to cut electric consumption about 20 percent. And we've increased oil production as much as 226 percent, because the SALT system optimizes the pump."

On beam pumps, the VLT SALT drive varies the pump speed with each stroke to maximize efficiency. It goes a little slower on the down stroke to avoid bending the rod, then makes up the lost time by going faster on the upstroke.

"The Danfoss VLT SALT uses a patented algorithm designed especially for artificial lift systems," says Butler. "In hundredths of milliseconds, the drive responds to changes in torque, speed, viscosity flow, the affects of downhole temperature and pressure changes. But it doesn't need any sensors to monitor those conditions. It just looks »



Avoiding the heavy amperage draw during restarts has allowed Noble Energy to cut electric consumption about 20 percent and increase oil production as much as 226 percent.

"In hundredths of milliseconds, the drive responds to changes in torque, speed, viscosity flow, the affects of downhole temperature and pressure changes."

— Randy Butler, Danfoss Distributor

3 types

The Danfoss VLT SALT applies to all three types of pumps being used by Ellis, namely:

1. THE BEAM/ROD PUMPS
2. ELECTRIC SUBMERSIBLE PUMPS
3. PROGRESSIVE CAVITY PUMPS (PCP).

at the motor's load characteristics and understands the conditions the pump is facing. Then the SALT algorithm makes the appropriate adjustments automatically."

The Danfoss VLT SALT applies to all three types of pumps being used by Ellis, namely: the beam/rod pumps, which use a barrel, valves and plunger that fit inside the well to gather fluids and lift them to the surface; electric submersible pumps, which are immersed in the fluid and use a centrifugal impeller to propel the fluids to the surface; and progressive cavity pumps (PCP), which use a motor with a stator and rotor, and the rotor-type auger that screw fluids up to the surface.

On electric submersible and PCP pumps, the VLT SALT controller can instantly detect gas pockets that could cause the pump to accelerate to dangerously high speeds—a condition known as cavitation. The SALT controller slows the pump down to let the gas pass, then returns to normal increase—and will repeat the process until the gas is eliminated.

The VLT SALT system also has a unique sand-purge algorithm that runs the pump at full speed to clear sand out of the bore hole before the pump seizes.

Besides improving pump performance, the VLT SALT system made installation easy. "I can cut external sensors, load cells, position indicators and pump cards," says Butler. "That's why a VLT SALT system installs in a quarter of the time required for traditional pump-off controllers. Plus, reduced electric consumption means smaller motors and transformers can be used. It's really a great solution for increasing efficiency and productivity."

Noble Energy's David Ellis agrees: "Across the board, I'm seeing oil production increases of 51 percent on the rod pumps and 187 percent and 226 percent on two wells with PCP pumps. Add that to longer equipment life and lower electric consumption, and I'd say that Danfoss' sensorless artificial lift solution is really worth its salt." ■

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