

Benefits of Screw Pumps in Oil-and-Gas Fluid-Handling Applications

WHILE CENTRIFUGAL PUMPS HAVE TRADITIONALLY BEEN THE DOMINANT TECHNOLOGY IN THIS REALM, THE FLOW-RATE, VISCOSITY AND EFFICIENCY ADVANTAGES OF SCREW PUMPS MAKE THEM A VIABLE ALTERNATIVE

By Josh Pepper and Michael Moore



While centrifugal pumps have earned a reputation as a go-to pumping technology for the wide-ranging fluid-handling applications in the expansive oil-and-gas industry, their operational shortcomings can mean that they are not always the best, most efficient choice. One technology that can improve flow rates, viscosity-handling range, energy efficiency and total cost of ownership is the positive displacement screw pump, with Blackmer® offering its Twin Screw With Timing Gear (WTG) and Triple Screw models as alternatives to centrifugal pumps in critical oil-and-gas fluid-handling applications.

Introduction

As human beings, we are programmed, whether consciously or subconsciously, to embrace the familiar. At the same time, when asked to complete a task, we are apt to identify the easiest way, or choose the path of least resistance, to get it done. When these two things – familiarity and ease – merge, a sense of complacency can be created, a feeling that “this is the best way and there’s no reason to consider any others.”

Which brings us to the oil-and-gas industry. It is a complicated business, one that spans from the discovery of underground reserves to their recovery, gathering, refining, manufacturing, transport, storage and eventual marketing as consumer goods ranging from motor fuels and asphalt to chemicals and cosmetics. Throughout the various point in this massive production and supply chain, pumps are required to move fluids and gases to and from numerous points.

For many years, the pumping technology of choice in many fluid-transfer applications in oil-and-gas production has been the centrifugal pump. To be fair, centrifugal pumps have performed admirably in these situations. Their method of operation – fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into the volute discharge port – makes them well designed for the high-volume, severe-duty transfer applications that are common in the industry. Centrifugal pumps also work especially well with thin, water-like fluids that must be transported through networks of piping with variable flow rates.

So, it’s easy to see why centrifugal pumps have gained a reputation as a go-to technology in oil-and-gas fluid-handling applications. Still, there is an understandable sense of “if it ain’t broke, don’t fix it” thinking when it comes to considering alternatives to centrifugal pumps by operators in the industry. This article, however, will illustrate how a



different technology – positive displacement twin- and triple-screw pumps – can oftentimes be a more versatile, reliable and efficient choice than centrifugal pumps in critical fluid-handling operations in the wide-ranging oil-and-gas industry.

The Challenge

The most obvious challenge – and perhaps the toughest to overcome – in making the screw pump more prevalent in oil-and-gas applications is convincing the industry’s operators to move away from a technology that has become ingrained in their minds as the best one for numerous jobs. Generally speaking, the bulk of the fluids that are handled during oil-and-gas production in North America have very low viscosities and must be transferred at very high flow rates, which plays to the operational strength of centrifugal pumps.

Because centrifugal pumps have been successful in North America, other oil-producing regions of the world, especially the Middle East, have taken great pains to replicate the North American production infrastructure, which includes significant use of centrifugal pumps. In many cases, oil-and-gas production and processing systems have been designed around the pumping technology, rather than the other way around. This means that engineers are first familiar with centrifugal pumps and attempt to work within their operational limits. They know how centrifugal pumps operate, know their benefits and are confident that they are the best technology for what they are trying to accomplish.

To illustrate this mindset, in some cases a design engineer – instead of considering an alternative pumping technology – will blend or heat raw crude oil as a way to manipulate the process and get the viscosity of the fluid down to less than 300 cSt, which makes it easier for the centrifugal pump to transfer the fluid. What they are doing in this instance is reconditioning the fluid to fit the pumping technology – irrespective of the cost impact.

In other words, when measures like this are taken to satisfy the needs of the pump, the popularity of centrifugal pumps in oil-and-gas fluid-transfer applications becomes something of a self-fulfilling prophecy.

Despite the ability to recondition the fluid to meet the operational needs of the centrifugal pump, operators must still take care to ensure that the centrifugal pump is operating on what is known as its “Best Efficiency Point,” or BEP. The BEP is the point where the centrifugal pump is working at its highest level of efficiency. Centrifugal pumps rarely operate at their exact BEP because pristine pumping conditions are rarely realized, but a centrifugal pump that is

able to function in a window between 80% and 110% of its BEP is said to be functioning adequately.

However, when the operation of the pump moves too far off its BEP uneven pressure will be applied to the impeller, which can result in increased radial thrust that will cause the pump’s shaft to “deflect.” When this deflection occurs, higher loads will be placed on the bearings and mechanical seal, which can lead to damage to the pump’s casing, back plate and impeller. Ensuring operation at the BEP can be a time-intensive task as the pump must be monitored constantly and adjusted, which costs time and money.

Additionally, meeting production rates and quotas has always been job No. 1 in oil-and-gas operations, but as operating costs have continued to rise, there has been a call for increased operational efficiency in terms of the amount of energy that is required and consumed during pumping operations. In this area, centrifugal pumps can also fall short:

- Due to pump-selection complexity, over-sized pumps are often chosen, resulting in increased operating and maintenance costs, inefficient operation and higher-than-necessary energy consumption
- As pump differential pressure increases, the flow rate decreases. Therefore, time-sensitive operations that are dependent upon maintaining a constant flow rate will take longer, which may be costly
- The performance of a centrifugal pump will be adversely affected when pumping a fluid that has a viscosity greater than 100 cSt.

These inefficiencies will lead to higher utility bills and have an undoubted effect on the operation’s bottom line.



Blackmer S Series Triple Screw Pumps are made to handle clean lubricating fluids without solid content across a wide range of viscosities, temperatures and pressures. This method of operation delivers smooth, constant product flow with low noise and high levels of energy efficiency, which are critical concerns in oil-and-gas fluid-handling applications.



Blackmer S Series Twin Screw Pumps With Timing Gear (WTG) have been designed with external bearings and a timing-gear transmission, which produces double-suction, self-priming operation with no metal-to-metal contact between the pump's internal components. This design helps the pump achieve the highest flow rates of any rotary PD pump, even at varying backpressures and viscosity levels.

The Solution

As mentioned, the solution to the shortcomings of centrifugal pumps can be positive displacement (PD) screw pumps. The problem is not only overcoming the built-in advantages of the centrifugal pump's vast installed base, but getting design engineers to acknowledge or even become aware that there are alternatives like screw pumps.

Simply put, many engineers are not taught about screw pumps in their studies, and many who are aware of them have a preconceived notion of their shortcomings, or that they are nothing more than lube pumps capable of handling only low flow rates. In reality, today's screw pumps have experienced remarkable advancements in terms of the flow rates that they can handle, with flow ranges from 220 gpm (833 L/min) to 11,000 gpm (41,635 L/min) not uncommon.

In truth, the design of PD screw pumps makes them capable of handling various liquids – even those with higher viscosities, such as the crude oil that is now being recovered in some areas of Canada and the rest of the world. The operating principle sees opposed screws engaged to form a sealed cavity with the surrounding pump casing. As the drive screws turn, the fluid is shifted and steadily and constantly conveyed to the discharge port of the pump, which creates a volumetrically consistent flow rate regardless of the pumping pressure.

The list of benefits provided by screw-pump technology in oil-and-gas fluid-handling applications is a long and impressive one:

- Ability to handle a wide range of flows, pressures, liquid types and viscosities
- Constant flow, even in the presence of varying system backpressures due to viscosity changes
- High volumetric and overall operating efficiencies, resulting in reduced operational costs
- Controllable output via variable capacities
- Low internal velocities
- Self-priming operation and good suction characteristics
- High tolerance for entrained air and other gases – a prime consideration in oil production
- Low mechanical vibration lengthens service life
- Intrinsically smooth and quiet operation
- Extremely low pulsation reduces stress and prolongs life of associated fluid-transfer components (piping, hoses, etc.)

Realizing the operational advantages that can be achieved when using screw pumps in oil-and-gas fluid-transfer applications, Blackmer®, Grand Rapids, MI, USA, a leading provider of pumps and compressors for industrial use, and a product brand of PSG®, Oakbrook Terrace, IL, USA, a Dover company, has developed the S Series Screw Pump product line.

Specifically, Blackmer recommends two of its S Series pump models –Twin Screw With Timing Gear (WTG) and Triple Screw – for oil-and-gas fluid-transfer activities.

The Twin Screw (WTG) pumps have been designed with external bearings and a timing-gear transmission, which produces double-suction, self-priming operation with no metal-to-metal contact between the pump's internal components. This design helps the Twin Screw (WTG) pump achieve the highest flow rates of any rotary PD pump, even at varying backpressures and viscosity levels. In fact, the deliverable flow rate of a PD screw pump, unlike a centrifugal pump, actually increases as the fluid's viscosity increases. These design characteristics also make screw pumps suitable for all types of transfer applications, including low- or high-viscosity, lubricating or non-lubricating, neutral or aggressive, and clean or contaminated fluids.

The Triple Screw pumps are made to handle clean lubricating fluids without solid content across a wide range of viscosities, temperatures and pressures. They are designed with a male drive spindle, two female secondary spindles and a case that contains the screws, which allows the fluid to move smoothly and continuously in an axial direction from suction to discharge. This method of operation delivers smooth, constant product flow with low noise and high levels of energy efficiency.





Realizing the many different fluid-handling applications that are encountered in the oil-and-gas production and supply chains, Blackmer offers a complete family of highly efficient and versatile twin and triple screw pumps.

Conclusion

We all like things that are familiar; they provide comfort in a world that seems to be changing much too rapidly. Therefore, it's easy to see why operators in the various segments of oil-and-gas production – upstream, midstream and downstream – have come to rely so heavily on centrifugal pumps for their fluid-transfer needs – it is a technology that has proven over many years to satisfy their demands in optimizing a very complicated production and supply chain.

But when we become entirely wedded to one way of doing things we become blind to alternatives that may be even more successful than the status quo. Such is the case with PD screw pumps and the role they could play in optimizing fluid transfer in oil-and-gas operations. While screw pumps

may have a higher purchase cost than centrifugal pumps, it's best to remember this old bromide: "buying cheap just means you'll have to buy it again." And, anyway, the main operational advantages that screw pumps have – the ability to handle a wider window of fluid viscosities at higher rates and pressures, lower energy consumption and no BEP to be concerned about – leave them poised to become a more efficient, reliable and versatile alternative to centrifugal pumps in critical oil-and-gas fluid-handling applications.

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