Advantages of Magnetic-Drive Positive Displacement Pumps in Chemical Processing

ADVANCES IN SLIDING VANE AND INTERNAL GEAR SEAL-LESS PUMP TECHNOLOGIES MAKE THEM A BETTER CHOICE THAN CENTRIFUGAL PUMPS OR MORE WELL-KNOWN POSITIVE DISPLACEMENT PUMP OPTIONS

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Seal-less mag-drive vane and internal gear pumps offer essential functional and performance benefits while moving liquids effectively and optimally within chemical processing facilities.

Introduction

Chemical-processing facilities use a wide array of flowing substances that must be processed, stored and transferred during manufacturing activities. The technology tasked with facilitating this liquid movement is the industrial pump. As befits what has grown into a very large global industry, a number of competing technologies are constantly positioning themselves to grab the attention – and capital-investment dollars – of the world's chemical processors.

The oldest of the pump debates has divided camps into those that favor centrifugal pump technologies and those with an affinity for positive displacement (PD). Centrifugal technology uses kinetic energy to transfer liquids from inlet to outlet. It works best when the pump is operating at or near its Best Efficiency Point (BEP). Positive displacement pumps capture a fixed volume of liquid and transfer it using cavities like "clockwork". PD pumps operate near peak efficiency regardless of speed, pressure, or viscosity conditions.

These distinctions have led some to call centrifugal pumps "emotional machines" since changes in pumping conditions directly influence their operational capabilities. PD pumps are described as "stoic," with the pump steadfastly achieving peak efficiency at all times regardless of changes in operating conditions. In recent years the discussion has begun to revolve around another design distinction: is the best chemical processing pump – be it PD or centrifugal – sealed or seal-less? This article will answer that question while illustrating that seal-less PD sliding vane and internal gear pump technologies may ultimately be the best choice within the realm of the PD pump universe.

(Un)Sealing The Deal

It's simple, really: sealed pumps use dynamic seals to keep the liquid contained, while seal-less pumps do not require dynamic seals to contain the liquid. Sealed pumps can accommodate a constant bleed of trace fluid across the seal faces (even in double seals), whereas seal-less pumps offer true leak-free operation. Although sealed pumps remain more common, seals are viewed as the weakest link in a pump's

Blackmer E Series Magnetically Coupled Internal Gear Pumps have a simple design that features only seven main components.

operational chain, with analysis of pumping operations indicating that upwards of 80% of all pump failures originate at the seal. A quick tour through any chemical-processing facility will support this hypothesis: look for wet baseplates and empty baseplates. Both indicate reduced uptime related to a failure in a sealing device.

Now, this doesn't mean that all of these failures are solely the seal's fault. In fact, there are many operational occurrences – pulsation; vibration; shaft deflection; dry run; viscosity, temperature and pressure changes; and liquid crystallization, to name just a few – that can cause the seal to leak or fail, either of which will put the pump out of service. Regardless, a compelling case is created for seal-less pumps since using this pumping technology would theoretically remove 8 of every 10 seal-related downtime occurrences, 8 of the 10 times ancillary costs for maintenance and repair are incurred, 8 of the 10 times you need a maintenance staff or, to sum it all up, 8 of the 10 headaches that are inherent in operating a pump.

So, if we can agree that there are compelling reasons to consider incorporating seal-less pumps in a chemical-processing operation, the next question becomes, "Which type of seal-less pump?" Which brings the discussion back to the centrifugal or PD pump conundrum.

There has been recent growth in next-generation seal-less designs that feature a magnetic-drive coupling that is used to transmit torque to the pump. In these configurations, a magnetic coupling connects the driving shaft to the driven shaft without use of a dynamic seal to keep the pumped liquids contained.

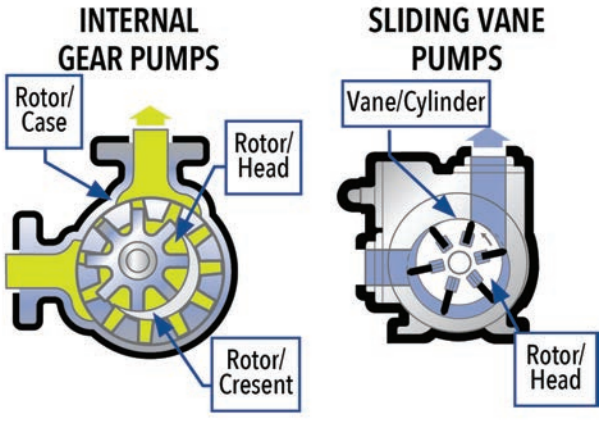
Admittedly, mag-drive seal-less pumps typically have a higher purchase price than basic sealed pumps, but as the seals and accompanying seal-support systems get more complicated – and remain more prone to failure – they get more expensive. For example, a triple-lip seal can cost $3,000, and if you're repairing or replacing it every 12 to 18 months that cost will add up, along with the added expense of any maintenance or repair calls. Or, for double mechanical seals that require seal-support systems, the seal-support system adds $4,000 to $8,000 itself in purchase cost, plus associated costs for monitoring equipment.

Financial considerations aside, mag-drive seal-less PD pumps outperform their seal-less centrifugal cousins by offering new functionality that is not possible with centrifugal pumps. First, seal-less PD pumps are self-priming and have good suction-lift capabilities while mag-drive centrifugal pumps, just like sealed centrifugal pumps, rely on an integral reservoir that must be pre-filled before it is turned on, meaning that they technically are not self-priming pumps, but pre-primed pumps. Second, seal-less PD pumps allow for bi-directional operation. Simply rotate the pump forward or backwards to achieve line stripping in either direction, saving on fluid waste and improved safety in your facility. Third, seal-less PD pumps are not sensitive to changes in operating environment (liquid or system conditions), unlike centrifugal pumps, which must be tuned to a single BEP or they will react negatively to changes in their environment. Finally, seal-less PD pumps can dry run for extended periods, process suspended solids, and accommodate zero-NPSHa systems, whereas centrifugal pumps struggle in each of these areas.

Assessing the PD Options

With centrifugal pumps removed from the equation, it's time to fully consider the seal-less PD options. The most popular in chemical-processing applications have proven to be air-operated double-diaphragm (AODD) and peristaltic (hose) pumps. The standout feature of both of these technologies is their ability to pull a perfect vacuum, which thereby enables them to self-prime and achieve good suction lift.

Specifically, AODD pumps are a first-choice seal-less technology for utilitarian pumping applications for a number of reasons: they are inexpensive, very flexible and easy to operate (all you need is an air hose and suction pipe). There are also some shortcomings: their flow and pressure capacities



are narrower than some other PD pump technologies, they create pulsation in the liquid path and because air is expensive, they can be costly to operate, especially when used in continuous-duty applications.

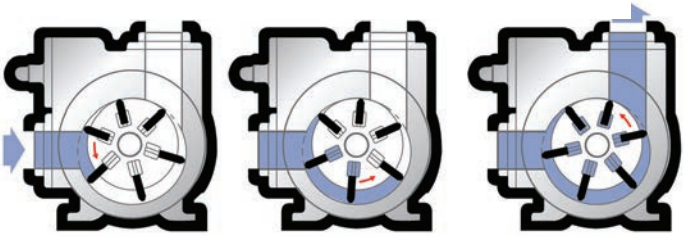
Peristaltic pumps are ideal for handling thick slurries and liquids with large solids. They deliver flow rate consistency despite changes in pressure, but the flow range is limited. Additionally, pulsation can occur making it difficult to dial in a specific flow rate. From a footprint standpoint, peristaltic pumps are larger than many other technologies, which means they require more operating space. Also, when/if the pump's hoses fail, a catastrophic leak can occur, and hose degradation during operation can compromise the integrity of more sensitive liquids.

Now let's consider seal-less mag-drive vane and internal gear pumps. The basic advantages of these mag-drive pumps are that are that they:

- Are electrically driven, so there is no need for compressed air
- Have a wide and consistent flow-rate range
- Create no pulsation in the liquid
- Operate well at higher temperatures
- Are immune to changes in liquid viscosity or pressure
- Are truly self-priming, meaning they can prime while being bone dry, right out of the box.

Let's take a closer look at the specific advantages of each technology:

SLIDING VANE PUMPS



- **Sliding Vane:** Sliding vane technology self-compensates for wear, sustaining new performance throughout the pump's operational life. Vane pumps uniquely allow a wide viscosity and pressure range, and are well suited for challenging applications like those with suspended solids, varying system pressure, zero NPSHa, liquid/vapor mix, and regular dry-run operation. The latest advancement in sliding vane pumps is the Blackmer MAGNES Sliding Vane Magnetic Drive Pump that offers a seal-less magnetic-drive technology that offers a first-in-class combination of reliability, functionality, and flexibility.

RELIABILITY: MAGNES, the new mag-drive sliding vane pump allows for extended and expected dry-run; suspended-solids levels of up to 20%; zero-NPSHr performance that is ideal for challenging pump inlet conditions, including with liquids featuring up to 20% vapor or air content; and provides peace-of-mind uptime without use of nuisance current-monitoring systems.

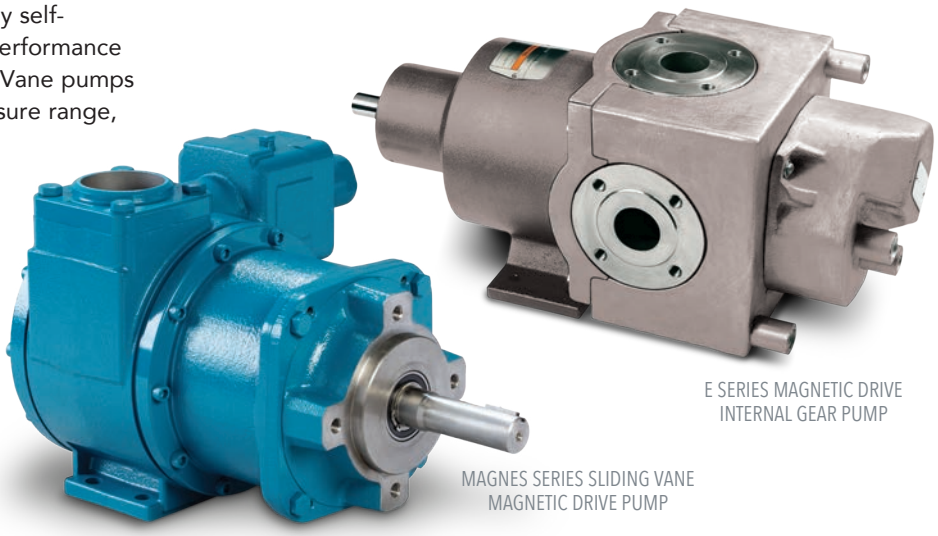
FUNCTIONALITY: MAGNES Series Sliding Vane Magnetic Drive Pumps can achieve suction lift of more than 25 feet (7.6 meters) without need to pre-prime the system; provides bi-directional flow; and can line strip to reduce product waste during or after production runs.

FLEXIBILITY: MAGNES provides a wide operating range that is immune to changing fluid and system conditions. Further, the flow and pressure range of 15 unique centrifugal frame sizes is achieved with just 2 vane pump sizes, optimizing asset flexibility.

- **Internal Gear:** Blackmer E Series is an advanced magnetically coupled internal gear pump that has a simple design that features only seven main components.

INTERNAL GEAR PUMPS

The heart of the design is a bearing-to-bearing support system that eliminates leaks. E Series Internal Gear Magnetic Drive Pump's short spindle also overcomes the challenges that are inherent in pump technologies with longer spindles, namely the impact of overhung loads that can lead to premature wear and failure. Unlike centrifugal pumps that rely on cantilevered bearings, E Series Internal Gear Pumps have symmetrical shaft support, which eliminates shaft deflection during operation, resulting in less maintenance and downtime.



E SERIES MAGNETIC DRIVE INTERNAL GEAR PUMP

MAGNES SERIES SLIDING VANE MAGNETIC DRIVE PUMP

Another standout feature of the Blackmer Gear E Series design is a single liquid chamber that improves liquid circulation through the coupling area. This results in longer magnet life, lower operating temperatures, and more efficient cleaning and flushing processes. By comparison, some gear pump designs feature a long, tortuous flow path, which can raise the temperature of the liquid as it is being transferred to levels that can compromise magnet life.

So, now the decision involves a choice between MAGNES Sliding Vane Magnetic Drive Pumps and E Series Magnetic Drive Internal Gear Pumps. This chart can help the operators of chemical-processing facilities decide on the best choice for their specific applications from two top-end technology solutions:

DESCRIPTION	MAGNES SERIES SLIDING VANE MAGNETIC DRIVE PUMP	E SERIES MAGNETIC DRIVE INTERNAL GEAR PUMP
Max. Flow Rate	520 gpm (1,968 L/min)	500 gpm (1,893 L/min)
Max. Pressure	225 psi (15.5 bar)	200 psi (13.8 bar)
Temperate Range	-30°F to 240°F (-34°C to 115°C)	-30°F to 500°F (-33°C to 260°C)
Viscosity Range	0.2 cP to 500 cP	5 cP to 50,000 cP
Solids Handling	Suspended	Dissolved
Materials of Construction	Ductile/Cast Iron, Stainless Steel	Ductile Iron, Carbon Steel, Stainless Steel
Reverse Operation (Bi-directional pumping)	Yes	Yes
Heat Jacketing	No	Yes

Conclusion

When it comes to selecting a pump, operators won't go wrong when choosing gear or sliding vane technologies. The key comes down to choosing a pump that best suits their needs. For operators, the best pump will balance a combination of fluid properties, system layout, and performance function. Gear and sliding vane technologies offer essential functional and performance benefits that move liquids effectively and optimally.

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