

Blackmer® MAGNES Series Sliding Vane Pumps Solve Legacy Pain Points

OFFERING THE INDUSTRY'S FIRST COMBINATION OF FUNCTIONAL, RELIABLE AND FLEXIBLE SEAL-LESS PERFORMANCE, MAGNES SETS A NEW STANDARD FOR MAGNETIC-DRIVE PUMPS

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Many chemical-processing applications require pump technologies that are leak-free, dry-run capable, can handle solids, can operate off the Best Efficiency Point (BEP) and can run without any cavitation-causing net positive suction head (NPSH) imbalances occurring. Blackmer® has developed a pump technology that can handle all of those challenges with its new MAGNES Series Sliding Vane Magnetic Drive Pump.

Introduction

There are some things you just can't avoid: death, taxes – and a pump's common operational pain points – leaks, dry run, solids handling, cavitation-causing NPSH imbalance operation off the BEP and incomplete performance curves – that are inherent in chemical-transfer applications. It was in the 1980s that the first viable pump technology was created that could ostensibly deliver leak-free performance – a crucial front-of-mind concern in applications where the handling and transfer of high-value hazardous chemicals was required – with a design that could also mediate or eliminate the negative effects of the common operational pain points.

This technology was called seal-less, zero-leak or leak-free, and it had one main task: prevent the leakage of hazardous materials better than sealed pumps through a seal-less design. There are three reasons why leak-free performance in chemical-transfer applications is paramount:

- Most raw chemicals are expensive, meaning that they are too valuable to have leak out, get flushed down a drain

during a cleaning process after a product run, or get left behind in a storage tank, railcar, tank truck or piping system after an unloading event

- Many chemicals are too hazardous for humans to handle or be exposed to, which requires leak-free operation
- Many chemicals are caustic or corrosive, which makes them hard to seal and can lead to cracks, breaks or crystallization on the seal faces, resulting in leak-causing failures

As an unquestioned step forward in pump design, the first seal-less pumps appeared to possess the ability to meet those three challenges, but they were not readily embraced at the outset because:

- They were significantly more expensive than traditional sealed pump technologies
- There was broad skepticism regarding whether or not the seal-less design could truly deliver on its leak-free promise

It wasn't until the early 2000s that seal-less pump technology had evolved to the point where it could claim to be both a

pain-point resolver and totally leak-free. A change in the mindset of the user also helped – leak-free pumps were not just being used when handling hazardous materials, they were being used for the handling of basic liquids like water. This mindset changed because users had become less willing, or capable, of accepting or dealing with seal failures than they were 50 years ago. In other words, even a so-called “nuisance” water leak would require the pump to be taken offline, which would result in expensive downtime and maintenance costs. The solution: pivot to a seal-less leak-free pump that would never (theoretically) need to be maintained or repaired because of a leak incident.

This combination of change in mindset and the now field-proven capabilities of seal-less pumps has turned the pump industry on its head. Today, after steady growth over the past 15 years, the global seal-less centrifugal pump market is valued in excess of \$4.5 billion. In fact, sales of seal-less ANSI centrifugal pumps have the potential to eclipse sealed-pump sales in the coming years. But despite all that, there remain challenges that seal-less pumps must overcome.

The Challenge

At this point – while acknowledging that seal-less pumps have essentially cured the chemical-leak conundrum – let’s delve deeper into the causes and effects of the common pump pain points and highlight how centrifugal pumps and internal gear pumps have risen as the leading technologies in the ongoing battle to optimize pump performance.

The dominant technology for seal-less pumps in chemical-transfer applications has been centrifugal pumps because their manufacturers were the first to embrace the technology and develop what came to be recognized as the preferred leak-free pump style. The result is a class of pumps that offers leak-free performance with reasonable reliability when handling a wide range of chemical products. The success of centrifugal pumps also brought a rash of copycat models to the market, to the extent that there are now hundreds of “me too” brands available for purchase, which translates to increased market share.

Similarly, the manufacturers of internal gear pumps quickly adapted their legacy sealed and packed designs to accommodate a seal-less option. Keeping the internal pumping elements unchanged, the early seal-less gear pumps provided a basic leak-free technology that was attractive during the early development of seal-less pumps.

Despite their undoubted success in penetrating the seal-less market in chemical-processing applications, centrifugal and gear pumps have inherent design and operational attributes that create challenges for the user. These users should be aware of these characteristics when designing systems and selecting pump technologies. In short, chemical-transfer applications are rarely pristine and can be very unpredictable, often leading to pervasive system outages and equipment failures if the proper pumping solution is not deployed.

Specifically, we have the aforementioned common pain points in pump operation. Here’s a closer look at each and how seal-less centrifugal or gear pumps (or both) can fall short in satisfying these pump conditions:

- **Dry Run:** Dry run is defined as “operating a pump without any liquid,” but while the definition may be simple, the consequences of doing it can be anything but. When a typical seal-less pump rotates without liquid inside, it generates heat that leads to catastrophic failure of internal components. Gear pumps struggle because their internal components are constantly in contact, making them unable to handle dry-run operation without damaging internal gears, idlers, bushings and pins. Looking at centrifugal pumps, sleeve bearings are the weakest component. Various material options exist, but each leaves the pump vulnerable to dry-run failure:
 - Silicon Carbide cracks within seconds of beginning dry-run operation and requires use of power-monitoring systems to turn the pump off in the seconds before failure
 - Protective Coatings applied to traditional bushings provide a short cumulative wear allowance that is depleted away over time, is not renewable and eventually leads to failure, though when that failure is liable to occur is impossible to know succinctly
 - Composite Blends have self-lubricating benefits, but wear quickly and sacrifice useful life at the fast rotational speeds of centrifugal pumps, leading to failure
- **Solids Handling:** Most chemicals contain some level of suspended solids or particulates that come from either the process or supply tanks. The solids will rub against the pump’s casing and other internal components, causing wear. Vane, centrifugal and gear pumps rely on internal circulation paths, which can be clogged by solids and cause failure.

In the case of centrifugal pumps, the solids are thrown around at such high velocities that pitting and premature wear will occur even quicker. For gear pumps, the result of solids handling is the same as dry run: failure. Solids cause gear pumps to lock and fail. At best, solids wear down contacting gear components, resulting in reduced pump capacity.

The MAGNES sliding vane pump is less susceptible to high velocity damage often caused by entrained solids. Contact a Blackmer Applications Engineer for more details and to discuss your specific application before specifying.
- **NPSH Imbalance/Cavitation:** Every pump consumes net positive suction head (NPSH). If a pump consumes more NPSH than the system provides, vapor forms and cavitation will result. Cavitation is the violent implosion of entrained vapor bubbles that sends shock waves and vibrations through the fluid. Depending on the intensity and frequency of the cavitation, the pump’s internals degrade, leading to breakdowns, leaks and costly downtime and repairs or replacement. Gear pumps fail fast with vapor and thin liquids because of the galling of internal parts and failed bushings. Centrifugal pumps rely on converting

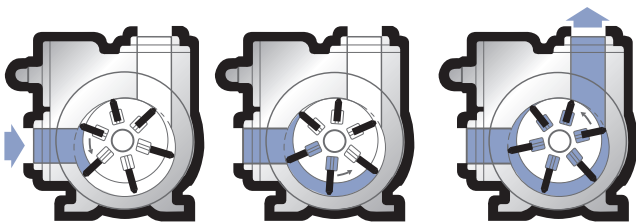
velocity head to pressure head, which is not possible with compressible entrained vapor. In short, both centrifugal and gear pumps fail when operating under sustained cavitation and poor NPSH applications.

- **Inflexible Operating Range:** Pumps are typically built to operate at a single specified design point. Meanwhile, these pumps are installed in dynamic systems that operate across a wide range of operating points. This is impactful to centrifugal pumps, which have a Best Efficiency Point (BEP), or the single operating point where they are most efficient. Maintaining operation close to BEP is critical to a centrifugal pump's reliability, because a centrifugal pump that operates outside of its BEP will see amplified loads that result in excess stress on the bushings and shaft. This stress leads to deflection, rubbing contact, premature wear, leak-path development and compromised product containment. Unlike centrifugal pumps, positive displacement (PD) pumps do not require BEP-reliant operation because they function consistently with changing environmental and liquid conditions. In this way, centrifugal pumps have a narrow operating range, whereas PD pumps offer flexibility to operate across the full system range.

The Solution

Sliding vane pumps have proven their standing as a first-choice alternative to centrifugal and gear pumps in chemical-transfer applications because they are simple to use, reliable and flexible. They don't require tuning to a single BEP; the vanes self-compensate for wear, sustaining like-new performance throughout the system's operational life; and they can easily handle pumping conditions that feature varying system pressure, zero NPSHa, liquid/vapor mix, suspended solids and regular dry-run operation.

The latest advancement in seal-less magnetic drive technology is the [MAGNES Series Sliding Vane Magnetic Drive Pumps](#) from Blackmer®. Offering a world-first combination of functionality, reliability and flexibility, the MAGNES Series delivers performance in severe-duty liquid transfer for high-value chemical-processing applications.



The operating principle of Blackmer® Sliding Vane Pumps ensures volumetric consistency through a number of self-adjusting vanes that slide in and out of the pump rotor, creating chambers that carry the same amount of fluid to the discharge port.

Chemical Transfer Capabilities Comparison for Sliding Vane, Centrifugal and Gear Pumps

	Sliding Vane	Centrifugal	Gear
No Cumulative Dry-Run Time Limit	YES	NO	NO
Solid & Abrasive Media Handling	YES	NO	NO
Cavitation & Vapor Mixtures Handling	YES	NO	NO
Low Required NPSH	YES	NO	NO
Full-Curve BEP Capability	YES	NO	YES
Leak-Free Pumping	YES	YES	YES
Seal-Less Technology	YES	YES	YES
Self-Priming Operation	YES	NO	NO
Product Recovery	YES	NO	NO

MAGNES Series Magnetic Drive Pumps solve legacy pain points with technically superior functionality that's designed for chemical and severe duty applications.

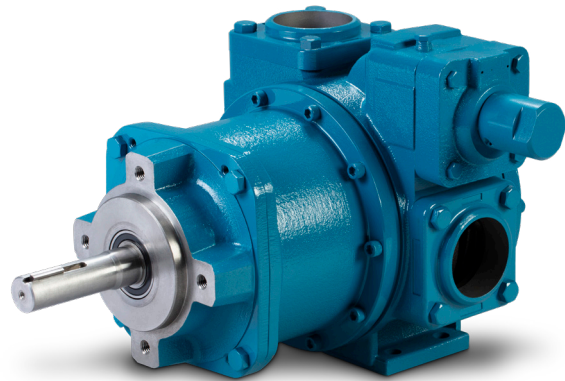
Key attributes include:

- **Indefinite Dry-Run Capability:** The MAGNES Series Pumps eliminate sensitivity to intermittent, extended and unexpected dry-run conditions. The dry-run capability is orders of magnitude better than competing technologies that rely on bushings made from sensitive ceramics, temporary coatings or soft composites. In contrast to pumps that boast of cumulative allowances, MAGNES has no cumulative dry-run time limit. Imagine the flexibility of being unaffected by poor operating conditions and operator error. Consider the increased functionality of self-priming, suction-lift, product-recovery and line-stripping operations.
- **Solids Handling:** Unlike most competing technologies that self-destruct when confronted with contaminants, the MAGNES Series Pumps can effectively process liquids with some level of suspended-solids.
- **Low to Zero NPSHr – Cavitation & Vapor Mixtures Handling:** Performing as a zero-NPSHr solution, the MAGNES Series Pumps are ideal for challenging pump inlet conditions, offering sustained performance with liquids featuring up to 20% vapor or air content.
- **Full-Curve Performance:** Unlike alternate options that must be tuned to a single BEP, the MAGNES Series Pumps have the robustness and flexibility to handle multiple changing fluid and system conditions. In other words, MAGNES provides the flexibility to operate across the full range of chemical-transfer systems.

- **Zero Leakage:** The containment shell is the foundation of a pump's leak-free capabilities. The MAGNES shell is unlike any currently available, as it offers dry run, unmatched pressure containment, maximum coupling rating and leak-free operation.
 - The metallic shells in competitive technologies have thin walls that maximize coupling strength; however, these competing metallic shells produce eddy-currents that generate heat and limit pump reliability.
 - Some competing non-metallic shells do avoid eddy-current heat issues; however, these competing non-metallic shells use unreinforced polymers or short carbon-fiber enforcement. As such, these competing shells require greater wall thickness that reduces coupling strength.
 - In contrast, MAGNES containment shells use a proprietary design and production process. The MAGNES shell is constructed of long carbon fibers embedded in polyether ether ketone (PEEK). This gives the MAGNES containment shell the coupling strength of a thin-wall shell and the reliability of being eddy-current-free.
- **Zero Alignment:** With optional close-coupled drive design, MAGNES enables quick and easy system setup, eliminating time-consuming alignment processes
- **Self-Priming Operation:** With suction-lift capability exceeding 25 feet (7.6 meters), sliding vane pumps offer new functionality, reduce additional system operating costs and enhance safety for all operators by eliminating the need to pre-prime the system
- **Product Recovery:** Adds line-stripping ability that reduces product waste during or after production runs, recovering the cost of expensive liquids and enhancing safety for plant operators and their staff

MAGNES Series Sliding Vane Magnetic Drive Pumps are available in two sizes:

- **3-inch:** performance up to 260 gpm at 200 psi (984 L/min at 13.8 bar)
- **4-inch:** performance up to 500 gpm at 200 psi (1,893 L/min at 13.8 bar)
- Both sizes are offered in either ductile iron or stainless-steel construction and are proven at a wide range of viscosities (0.2 cP – 500 cP) and temperatures (-30°F to 240°F/-34°C to 115°C), while providing an expansive differential head range:
 - 659 ft (201 m) @ 0.7 SG
 - 461 ft (141 m) @ 1.0 SG
 - 355 ft (108 m) @ 1.3 SG



The Blackmer® MAGNES Series Sliding Vane Magnetic Drive Pump is the world's first pump that produces a combination of flexibility, functionality and reliability that solves legacy operating pain points while also delivering technically superior handling of hazardous chemicals in severe-duty applications.

Conclusion

The evolution of the seal-less leak-free sliding vane pump has reached its next level with the development of the MAGNES Series Sliding Vane Magnetic Drive Pump from Blackmer. This innovative new pump technology eliminates the pervasive pain points of legacy centrifugal and gear pumps in chemical-transfer applications. Namely, it has indefinite dry-run capability, can handle solids, operates well with cavitation and vapor mixtures, and offers full curve and system performance. Combine these features with a next-generation seal-less magnetic-drive design and chemical manufacturers have a revolutionary new option when searching for the best pump to deploy in their critical and severe-duty operations.

About the Author:

Chris Hordyk is an Application Engineering Manager for Blackmer, Grand Rapids, MI, USA. He can be reached at chris.hordyk@psgdover.com. Blackmer is a leading global brand of sliding vane, internal gear, regenerative turbine and centrifugal pump, and reciprocating compressor technologies for the transfer of liquids and gases. Blackmer is a product brand of PSG, a Dover company, Downers Grove, IL, USA. PSG is comprised of several leading brands, including Abaque, All-Flo, Almatec, Blackmer, Cryo-Mach, Ebsray, em-tec, Griswold, Hydro, Malema, Mouvex, Neptune, PSG Biotech, Quantex, Quattroflow and Wilden. For more information on Blackmer or PSG, please go to psgdover.com/blackmer or psgdover.com.

