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Applying the Correct Pump Technology

Many Factors Must Be Considered Before Choosing the Proper Pump for a Specific Application

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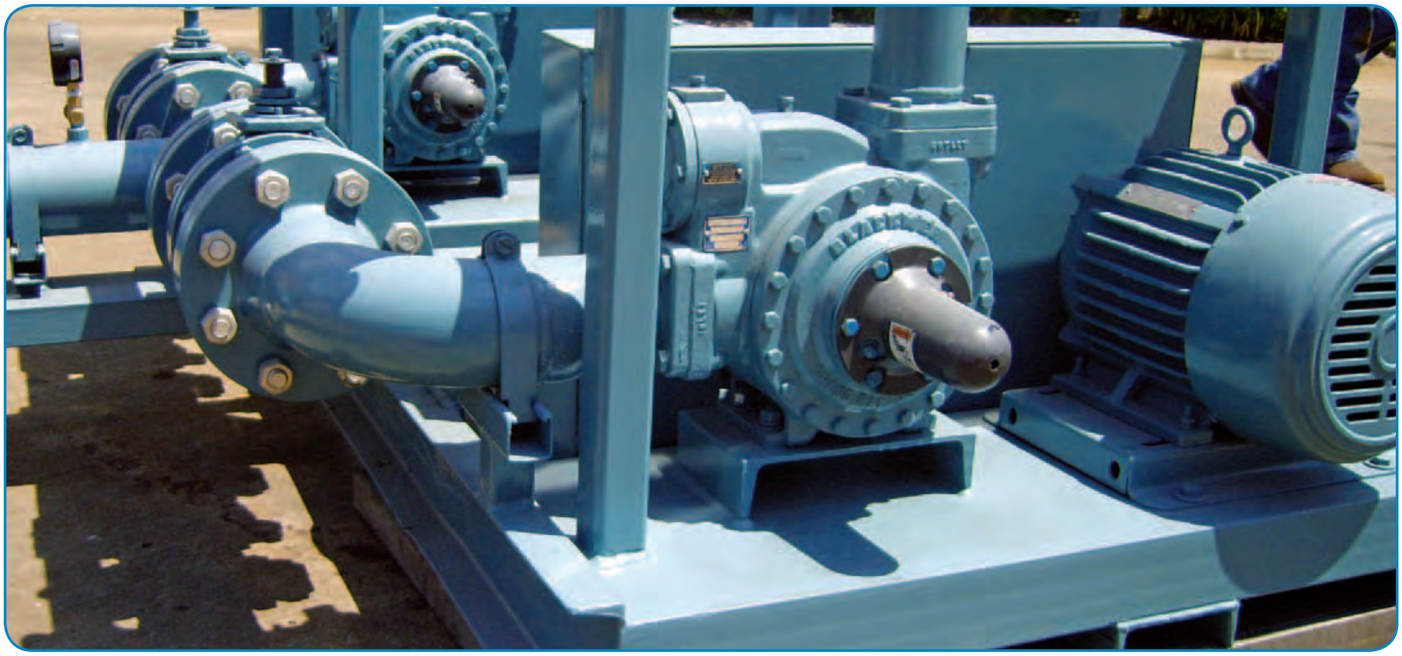


Positive displacement pump technology – such as that found in this sliding vane model – maximizes operating performance and efficiency across a wide range of product-transfer applications.

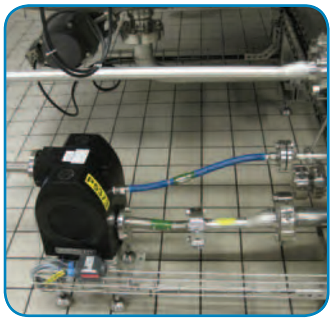
The Challenge

A baseball player doesn't stride to the plate to face a fireballing right-hander armed with a fly swatter. A professor of nuclear physics doesn't use *Fun with Dick and Jane* as a textbook. And you wouldn't unload a railcar filled with thousands of gallons of vegetable oil with a straw.

In other words, it's hard to do the job correctly if you aren't equipped with the proper tools. In the case of the first two examples, the solution is easy – bring a bat to the plate and provide your students with a textbook that covers the basics of nuclear physics. It's when we consider the third example that the list of things to consider grows exponentially before you can confidently choose the correct pump for the application – things like flow rate and required pressure and how they help to determine proper pump size, desired operating efficiency and total life cycle costs, product temperature and viscosity, suction-lift requirements, corrosive and erosive properties of the product and the material compatibility of the pumping equipment to those properties, the best way to ensure product containment and eliminate cross-contamination, how the pump will be driven and at what speed are among the considerations that immediately come to mind.

Incorporating all of these considerations into your pump-selection process can seem daunting. There are just so many technologies from which to choose. However, there is one basic technology that can maximize operating performance across a wide range of applications – positive-displacement (PD) pump technology. Basically, PD pumps cause a fluid to move by trapping a fixed amount of the fluid and then forcing that trapped volume into a discharge pipe. Due to this design and operation, PD pumps generally have more flexibility when dealing with the varying changes in pressure and flow requirements found in continuous or intermittent-type processes. PD pumps also maintain higher efficiencies across changing operating conditions, including viscosity changes, which can lead to improved energy efficiency.

With all of that said, this white paper will focus on a specific list of PD pumping technologies – air-operated diaphragm, sliding vane, metering, peristaltic (hose) and eccentric disc – and a synopsis of the applications in which they are effective, efficient and reliable.



The design of air-operated diaphragm pumps allows product flow to stay constant with the speed of the pump.

Air-Operated Diaphragm Pumps

Positive-displacement double-diaphragm pump technology was invented in 1955 as the solution for demanding utilitarian applications that require a robust pump design – from chemical and ceramic production to mining and waste-treatment applications. Diaphragm pumps are able to satisfy the demands of these industries because their design allows the product flow to stay constant with the speed of the pump. The pumps can be constructed with a multitude of elastomer options, including Teflon®,[1] to meet most all material-compatibility concerns.

An air-operated double-diaphragm (AODD) pump operates by displacing fluid from one of its two liquid chambers upon each stroke completion. The simple genius of AODD pump design means that there are only a few wetted parts that are dynamic: the two diaphragms, which are connected by a common shaft, the two inlet valve balls and the two outlet valve balls. The diaphragms act as a separation membrane between the compressed air supply and the liquid. Driving the diaphragms with compressed air instead of the shaft balances the load on the diaphragm, which removes mechanical stress from the operation and extends diaphragm life.

Major benefits of air-operated double-diaphragm pumps include their ability to be used in a wide range of pressure and flow specifications; self-priming and low-wear operation; ability to handle corrosive and abrasive solutions; consistent performance; and lower operational costs.

[1] Teflon® is a registered trademark of DuPont.

Sliding Vane Pumps

For more than a century, positive-displacement sliding-vane-pump technology has been the No. 1 choice for a wide variety of pumping applications. The list of applications where the use of vane technology sets the standard is virtually endless – transfer of petroleum fuels and lubes; handling of refrigeration coolants like Freon and ammonia; bulk transfer of LPG and NH_3; LPG cylinder filling; transfer of aerosols and propellants; and the transfer of solvents and alcohols are among the most popular.

Sliding vane pumps are ideal for these applications because they offer high efficiency and low maintenance when compared to other pumps, including gear pumps, traditionally utilized. These are important factors in today's environment of rising costs, lean personnel staffs and high demand for increased profitability. The secret to the success of vane-pump technology to satisfy these crucial considerations are the vanes that slide into and out of slots in the pump's rotor. The pump's rotation draws liquid in behind each vane and as the rotor turns, the liquid is transferred between the vanes to the outlet where it is discharged. This results in continuous optimal pump performance because each revolution of the pump rotor displaces a constant amount of fluid, while variances in pressure have a negligible effect. This means that energy-wasting turbulence and slippage in the pump are minimized and high volumetric efficiency is maintained.

There have also been recent advancements in vane-pump technology that have increased a pump's operational efficiency and longevity even more, including the development of cavitation/noise-suppression liners that control the wear effects of cavitation and reduce noise levels by up to 15 decibels. Motor-speed sliding-vane pumps have been engineered for continuous-duty operation. Many sliding vanes pumps can be serviced inline without removing suction and discharge piping.

All of this gives vane-pump technology a long list of advantages, including the ability to handle thin liquids at high pressures; dry-run capabilities; wear compensation through vane extension; and good vacuum pressure, which is why it is the top choice for many facility operators.

Metering Pumps

Simply defined, metering pumps are used to inject liquids at precisely controlled, adjustable flow rates – a process that is often called "metering." Controlled-volume metering pumps

Metering pumps are reciprocating positive-displacement pumps that have the capability to inject liquids at precisely controlled and adjustable flow rates.

are actually reciprocating positive-displacement pumps that can be used for the injection of chemical additives, proportional blending of multiple components or metered transfer of a single liquid. Their design characteristics make these types of pumps desirable for applications that require highly accurate, repeatable and adjustable rates of flow.

Therefore, metering pumps are most often used to pump chemical solutions and expensive additives that are used in products manufactured in a wide variety of industries, including industrial, medical, chemical, food and dairy, pharmaceutical and biotech, environmental, fuel cell and laboratory. Metering pumps have been designed to pump into low or high discharge pressures at controlled flow rates that are constant when averaged over time. In terms of construction, most metering pumps consist of a pump head – through which the substance being pumped enters an inlet line and exits through an outlet line – and an electric motor, the most commonly utilized driver.

Peristaltic (Hose) Pumps

The design and operational characteristics of peristaltic (hose) pump technology make it a wise choice in a wide range of applications—from moving viscous and/or abrasive slurries to the transfer of water-thin, non-lubricating fluids, corrosive chemicals and sheer-sensitive materials. These characteristics make peristaltic (hose) pumps ideal for such diverse industries as wastewater treatment, chemical processing and food manufacturing.

Peristaltic (hose) pumps are effective for a diverse array of applications because their operation moves products at a constant rate of displacement.

Peristaltic (hose) pumps satisfy the requirements of such a wide range of applications because their operation is based on the alternating contraction and relaxation of the hose, forcing the contents to move through the pump and into the discharge piping. A smooth-wall, flexible hose is fitted in the pump casing and is squeezed between shoes on the rotor and the inside of the pump casing. The rotating action moves the product through the hose at a constant rate of displacement. The hose restitution after the squeeze produces an almost full vacuum that draws the product into the hose from the intake piping. The pump casing is lubricated to cool the pump and lengthen the service life of the shoes and hose. Since the product only contacts the hose and not the internal pump components, this pumping technology is very suitable for abrasive and corrosive applications.

This pump style also maintains excellent volumetric consistency, making it ideal for dosing applications. The pump's seal-free design makes it dry-run capable and eliminates any potential leak or contamination points while providing superior suction lift. Finally, peristaltic (hose) pumps are easy to operate and easy to maintain. The pump's reversible operation allows for pumping in both directions.

The eccentric-disc pumping principle allows for the gentle transfer of fluids from suction to discharge with very low agitation and shear.

Eccentric Disc Pumps

The design of eccentric disc pumps allows them to be used in a wide scope of fluid-transfer applications – which is the hallmark of PD pump technology – from viscous to non-lubricating and volatile to shear-sensitive. Eccentric disc pumps are therefore a top choice in a variety of industrial and sanitary applications, including food processing, pharmaceutical manufacture, chemical processing, soaps, healthcare and cosmetic products, paper coatings, solvents, polymers and petrochemicals.

Eccentric disc technology consists of a stationary cylinder and disc that are mounted to an eccentric shaft. As the eccentric shaft is rotated, the disc forms chambers within the cylinder, which increase at the suction port and decrease at the discharge port. During operation, the discharge pressure exerts itself against the eccentric disc, preventing it from slipping. This low slip between the disc and cylinder gives eccentric disc pumps the ability to self-prime and line strip. Taken all together, this pumping principle allows for the gentle transfer of fluids from suction to discharge, with very low agitation and shear.

The benefits of using eccentric-disc technology for the operator include excellent self-priming capabilities, even when running dry; ability to maintain regular and constant output, even when the viscosity of the fluid changes considerably; the pump's self-adjusting radial and axial design that gives them greater efficiency and repeatability over time; and rugged reliability that allows them to maintain like-new performance levels without the need for excessive maintenance and equipment adjustments that can lead to profit-sapping downtime.

That's Not All

While choosing the proper pump technology for the specific application is the No. 1 concern for facility managers, that choice has been made more problematic in recent years with the increased awareness of energy usage by manufacturing facilities – particularly in the pumping systems they employ – and how it affects utility costs, profit margins and overall impact on the environment. "Green" is an essential part of the new bottom line for many manufacturers.

Pump design and operation can affect energy usage in a number of areas, and if not properly monitored can lead to "energy creep" that results in unintended energy waste.

In other words, making the most of energy and its efficient use is a never-ending challenge that plant managers and operators must confront on a minute-by-minute basis, 365 days of the year. In order to optimize energy use while maintaining the expected production quotas, plant managers must not only select the proper pump for the application but put serious thought, time and effort into utilizing the pumping technology that delivers the most energy-efficient operation possible.

This means that many manufacturers are turning Corporate Energy Management (CEM) principles that establish a set of parameters that move accountability for energy use to a firm's upper management, in the process creating a marriage that involves all parties in a firm's hierarchy and a smoother approach to finding the proper solution to operational questions. As manufacturers continue to incorporate the precepts of CEM into their operations, solutions to their energy-saving needs will be much easier to identify and implement. One of these solutions will be the reliance on PD pumps, which have a proven track record of being the most energy-efficient, thanks to their operational consistency.

Conclusion

As mentioned, choosing the right pump for a specific application is not as simple as grabbing the right bat or reading the proper textbook. It takes many hours of study and an appreciation of what the ultimate needs of the application are and the best way to meet them. This includes not only being familiar with the many pumping technologies that are available, but to also know which are the most efficient for your needs while also being the most bottom-line and environmentally friendly. It's a delicate balancing act, but one that must be mastered if a manufacturing application is to operate at its most efficient and profitable level. That's why more and more manufacturers are making positive-displacement pumps the fulcrum of their operations.

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