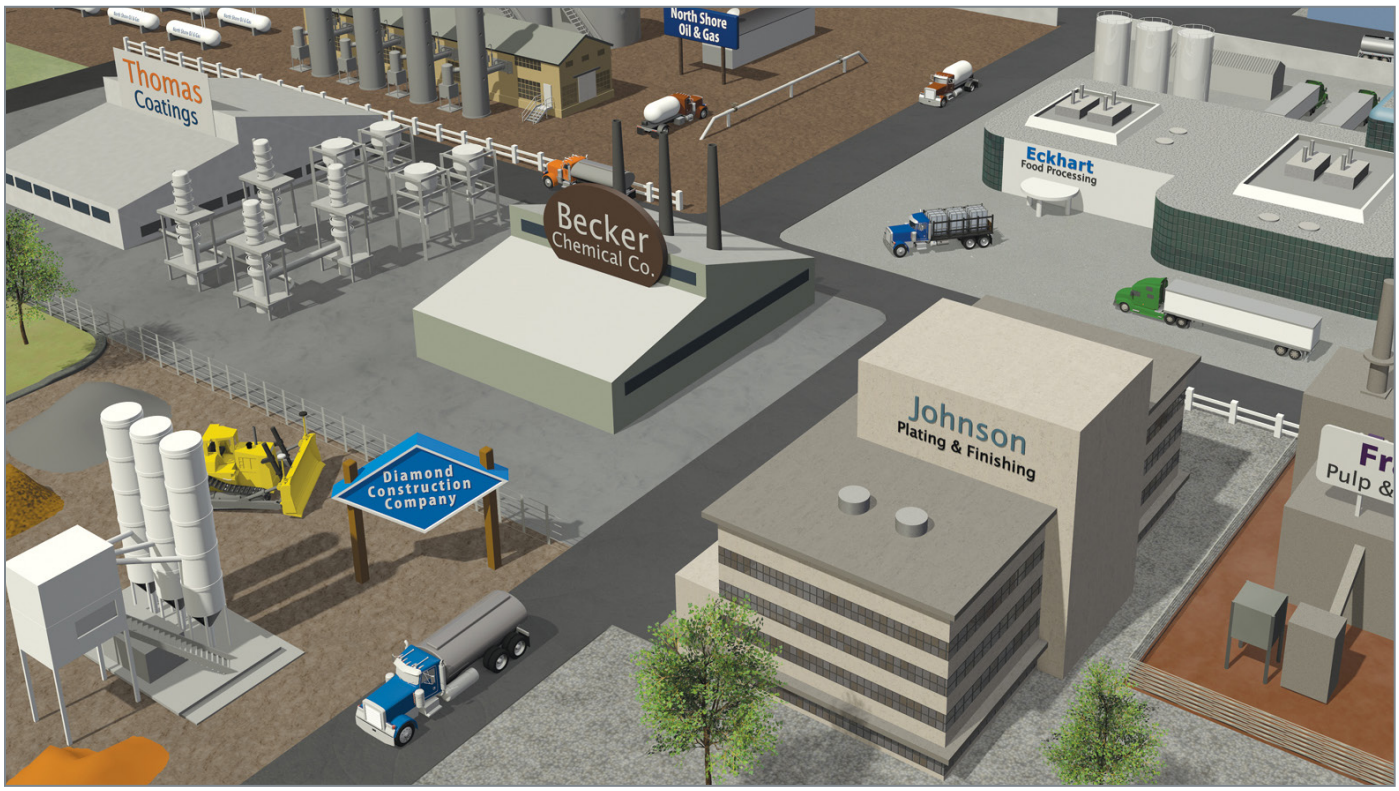
Conquering the Challenges of Latex Emulsion-Handling

WILDEN® BOLTED METAL AIR-OPERATED DOUBLE-DIAPHRAGM (AODD) PUMP TECHNOLOGY DELIVERS THE SHEAR-SENSITIVITY AND LEAK-FREE OPERATION REQUIRED IN THIS CRITICAL APPLICATION



Introduction

Handling emulsions can be very challenging. Even their basic definition – "a mixture of two or more liquids that are normally unblendable" – hints at the difficulties that may be lying in wait when creating and handling them. Still, examples where emulsions have been successfully created, ranging from common milk to cutting fluids used in metal working, can be found everywhere.

Latex is a complex, but stable, emulsion consisting of polymer microparticles contained in an aqueous medium. Like emulsions in general, latex – the most recurring images of which is the latex glove – is present in all types of common products, from paints and balloons to floor polishes and carpeting. Most latexes start out as simple emulsions in which droplets of the substance are added to water. This initiates a process known as "emulsion polymerization" in which the final product can be called latex.

Though latexes are very versatile and can be used to enhance a product's performance characteristics, such as durability, dimensional stability and chemical resistance, they require very precise manufacturing and handling processes. This article will identify and explain why one type of pumping technology – air-operated double-diaphragm, also known as AODD – is ideal for the demands of latex-handling.

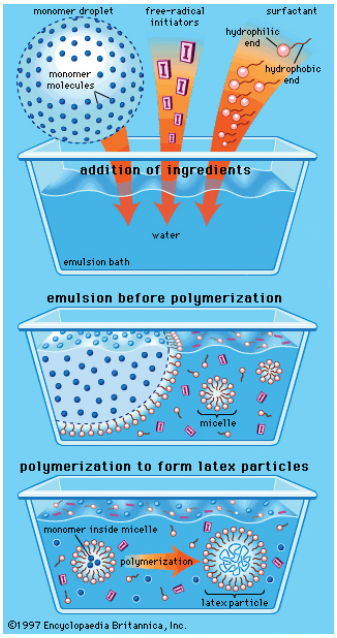
The Challenge

There are two basic challenges in pumping latexes:

- Latex emulsions are extremely shear-sensitive, meaning they require pumps that can reliably deliver gentle product handling that results in a low shear rate
- Any contact with air will further polymerize the latex, making it imperative that the pump feature a sealless design; pumps with mechanical seals also usually require flushing, which can create a possible leak path or dilution of the latex solution

Other pump characteristics that are desirable when handling latex emulsions include:

- Dry-run capability
- Ability to handle liquids with varying viscosities, from thin to high-grade viscosities
- Self-priming operation
- Portability
- Easy cleaning and maintenance



How Latex Is Produced By Emulsion Polymerization

A lesser consideration, but still an important one, is the climactic conditions in which the latex emulsion will be created and handled. Since most types of latexes are incapable of withstanding repeated freezing or thawing they need to be stored in temperatures above 40ºF (5ºC). They should also not be kept in temperatures above 100ºF (30ºC) for extended periods lest they become susceptible to surface drying that will compromise their performance.

Over the years, the search for the perfect pump to handle latex emulsions has led manufacturers to experiment with a number of different technologies, most of which feature operational "blind spots" that negatively affect their performance in latex-handling applications. Among these competitive technologies, and their respective operational drawbacks, are:

Gear Pumps

- Not recommended for shear-sensitive fluids
- If used, must be oversized and operate at very low speeds
- Seals prone to leakage
- Pressure relief valve required on discharge side of pump

Centrifugal Pumps

- Not recommended for, but known to be used with, thin emulsions
- Seals must have a flush pan and/or be cooled to prevent product buildup around the pump shaft
- Double mechanical seal or water seal with packing gland required
- Low-flow operation can cause pump failure
- May require priming

Progressive Cavity/Rotary Screw Pumps

- Expensive to maintain
- Hard to disassemble
- Pressure relief valve required on discharge side of pump
- Viscous materials require oversized pump operating at low speed
- Tight internal clearances
- Not dry-run capable
- Seals prone to leakage

Circumferential Piston Pumps

- Not recommended for shear-sensitive fluids
- Multiple seals are prone to leakage

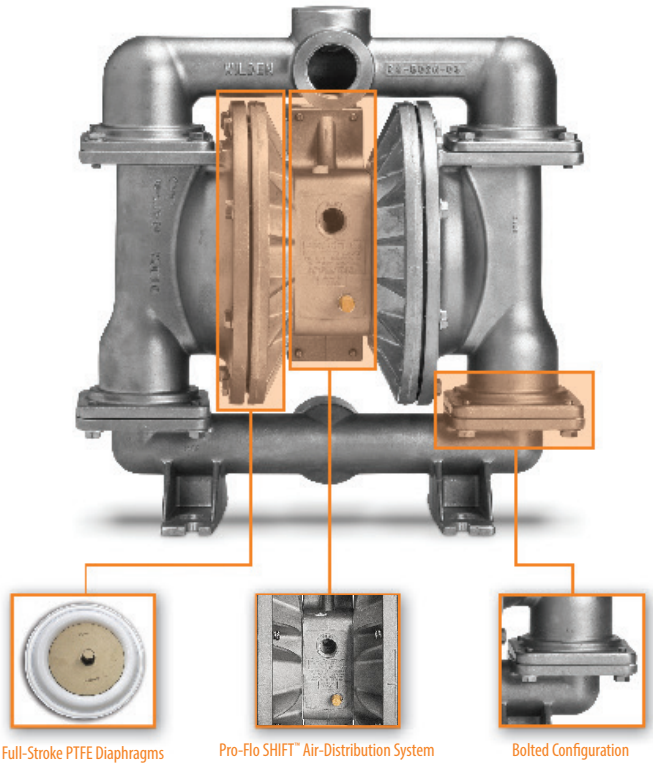
Peristaltic (Hose) Pumps

- Only suitable for low-flow applications

The Solution

While all of these aforementioned pump technologies have been found wanting when handling latex emulsions, one has risen to the fore – positive displacement air-operated, double-diaphragm (AODD) pump technology. AODD pump technology was invented in 1955 by Jim Wilden, the founder of the Wilden® and some 64 years later remains the leading choice in latex-handling applications.

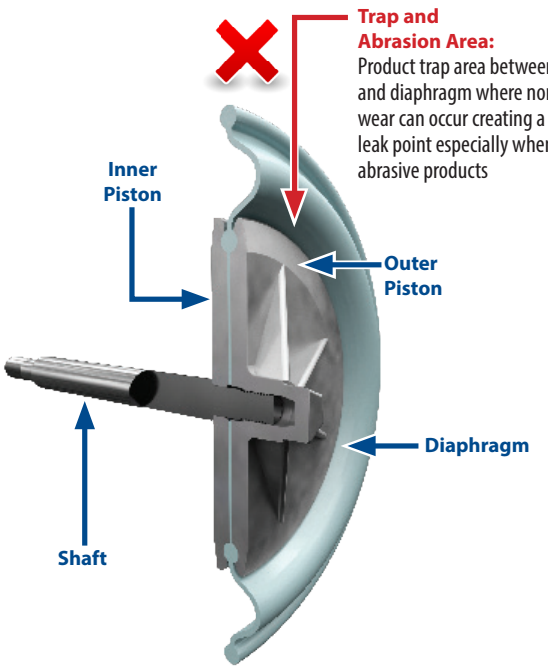
The particular pump that sets the standard in these operations is the Wilden Bolted Metal AODD Pump. Bolted metal pumps hit the latex-handling "sweet spot" because they feature a sealless, bolted configuration that ensures



Wilden® 1.5-inch bolted stainless steel

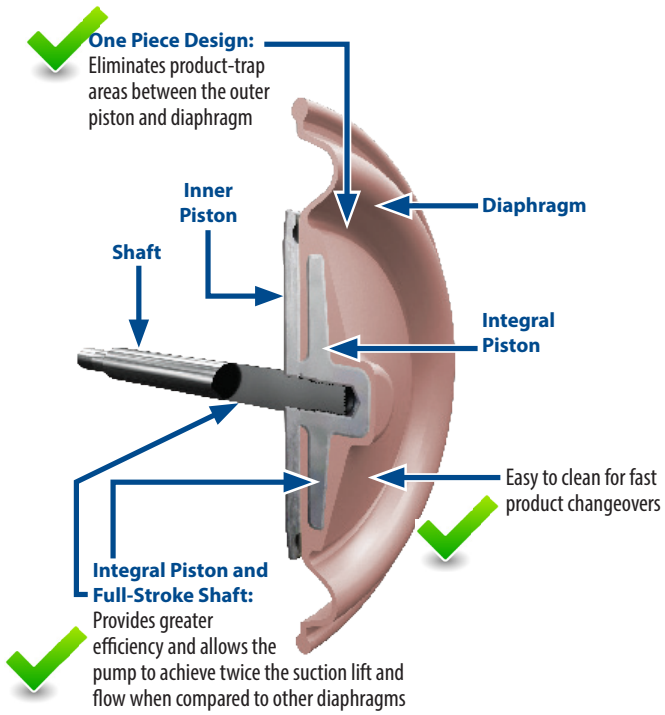
Standard Diaphragm

GOOD



Chem-Fuse Diaphragm

BEST



total product containment, while the design of the wetted path reduces internal friction, enabling the pump to deliver the level of shear-sensitive operation that is mandatory when working with latexes. The AODD pump's positive-displacement operating principle also guarantees that the product flow rate will remain volumetrically consistent.

Wilden offers its bolted metal pumps in a number of materials of construction, including aluminum, cast iron and stainless steel, which is generally preferred when handling latexes with PTFE elastomers. The Bolted Metal AODD Pumps are available in four sizes, from 25 mm to 76 mm (1-inch to 3-inch).

Wilden has also developed a number of enhancements that elevate the performance of its bolted metal pumps even more, including:

- ***Pro-Flo® SHIFT Air-Distribution System (ADS)*** – An innovative and simple ADS design that features an air control spool that automatically optimizes air consumption and eliminates overcharging of the air chamber with no reduction in flow rate, resulting in improved liquid-handling efficiency and lower energy costs.

- ***Drop-in Pump Configuration*** – Allows a pump to be installed in an existing footprint without the need to disturb the piping. These pumps have a larger flow path, resulting in increased flow rates and decreased energy consumption.

- ***Full-Stroke PTFE Diaphragms*** – The full-stroke design results in increased product displacement per stroke, which translates into greater flow rates and higher efficiencies when compared to AODD pumps that rely on reduced-stroke PTFE diaphragms.

- ***Chem-Fuse Integral Piston Diaphragms (IPD)*** – IPD design encapsulates the pump's piston within the diaphragm itself. This eliminates the diaphragm wear that can lead to the creation of potential leak points at the outer piston, resulting in leak-free operation and dependable product containment. The Chem-Fuse's Wil-Flex™ construction also makes them 50% less expensive than PTFE-laminate diaphragms.

These enhancements also equate to energy savings as lower amounts of compressed air are needed to maintain desired flow rates and pressures. All of these features combine to make Wilden's Bolted Metal AODD Pumps the ultimate answer for all latex-emulsion-handling applications in a wide array of industries.

Conclusion

Latex emulsion is, and will continue to be, a crucial component in any number of industries and the products they produce, some of which are as common as the adhesive on the back of a postage stamp. The sensitive handling characteristics, though, can make latex a difficult substance to transfer via pump – if ineffective pumping technology is employed. Over the years, manufacturers

How AODD Pumps Work

AODD pumps are classified as reciprocating, positive-displacement-style pumps. The pump operates by displacing fluid from one of its two liquid chambers upon each stroke completion. To operate, the AODD pumps require a given amount of pressure (measured in pounds per square inch) and air volume (measured in cubic feet per minute) to deliver the proper amount of fluid. This simple, yet ingenious, design enables AODD pumps to provide the shear-sensibility and sealless operation that are paramount considerations in latex production and handling.

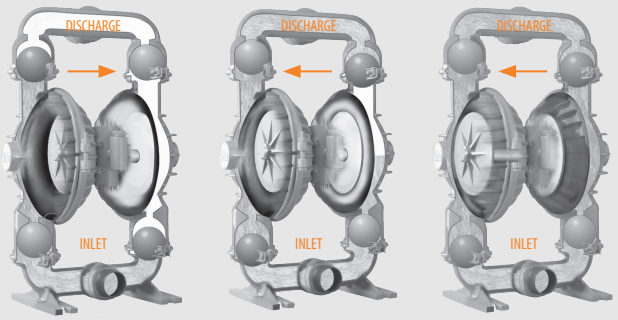
The simple genius of the AODD pump design means that there are only a few wetted parts that are dynamic: the two diaphragms, which are connected by a common shaft, the two inlet valve balls and the two outlet valve balls. The diaphragms act as a separation membrane between the compressed air supply and 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. This also allows the valve balls to open and close on the valve seats, which direct liquid flow.

This simple design and operation makes it easy for the operator to find the correct pressures and flows to optimize its operation.

More specifically, the pump begins operation when the air distribution system directs the air supply to the right air chamber and back side of the diaphragm. This moves the diaphragm away from the center block and toward the liquid chamber, in the process pulling the opposite diaphragm inward. This means the opposite diaphragm is now on its suction stroke. At the same time, atmospheric pressure forces fluid into the inlet manifold, forcing the inlet valve ball off its seat. This allows liquid to move past the inlet valve ball and into the liquid chamber.

When the pressurized right liquid chamber reaches its liquid capacity, the air valve redirects compressed air to the back side of the opposite diaphragm. This forces that diaphragm away from the center block while pulling the right diaphragm toward the center block. This closes the inlet valve ball on the opposite side while lifting the discharge valve ball off its seat and forcing the liquid to flow through the discharge manifold. The process is repeated for the opposite side, with the liquid chamber filling, the forced air redirecting the diaphragms and the created pressure forcing the discharge valve ball off its seat as the liquid moves through the discharge manifold.

As the pump reaches its original starting point, each diaphragm has gone through one suction and one discharge stroke, which constitutes one pumping cycle.



Right Stroke | Midstroke | Left Stroke

and handlers of latex emulsions have found that there is a pumping technology that reliably provides the required operational principles – positive displacement air-operated double-diaphragm pump technology.

For nearly 65 years, Wilden has been the acknowledged leader in creating AODD pump technology that can meet the demands inherent in latex-handling. Wilden AODD pumps, specifically those in its Advanced™ Series Metal family, feature not only the ruggedness, product containment and reliable operation that is needed, but also the finesse that is the hallmark of critical latex-handling operations.

WILDEN®

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