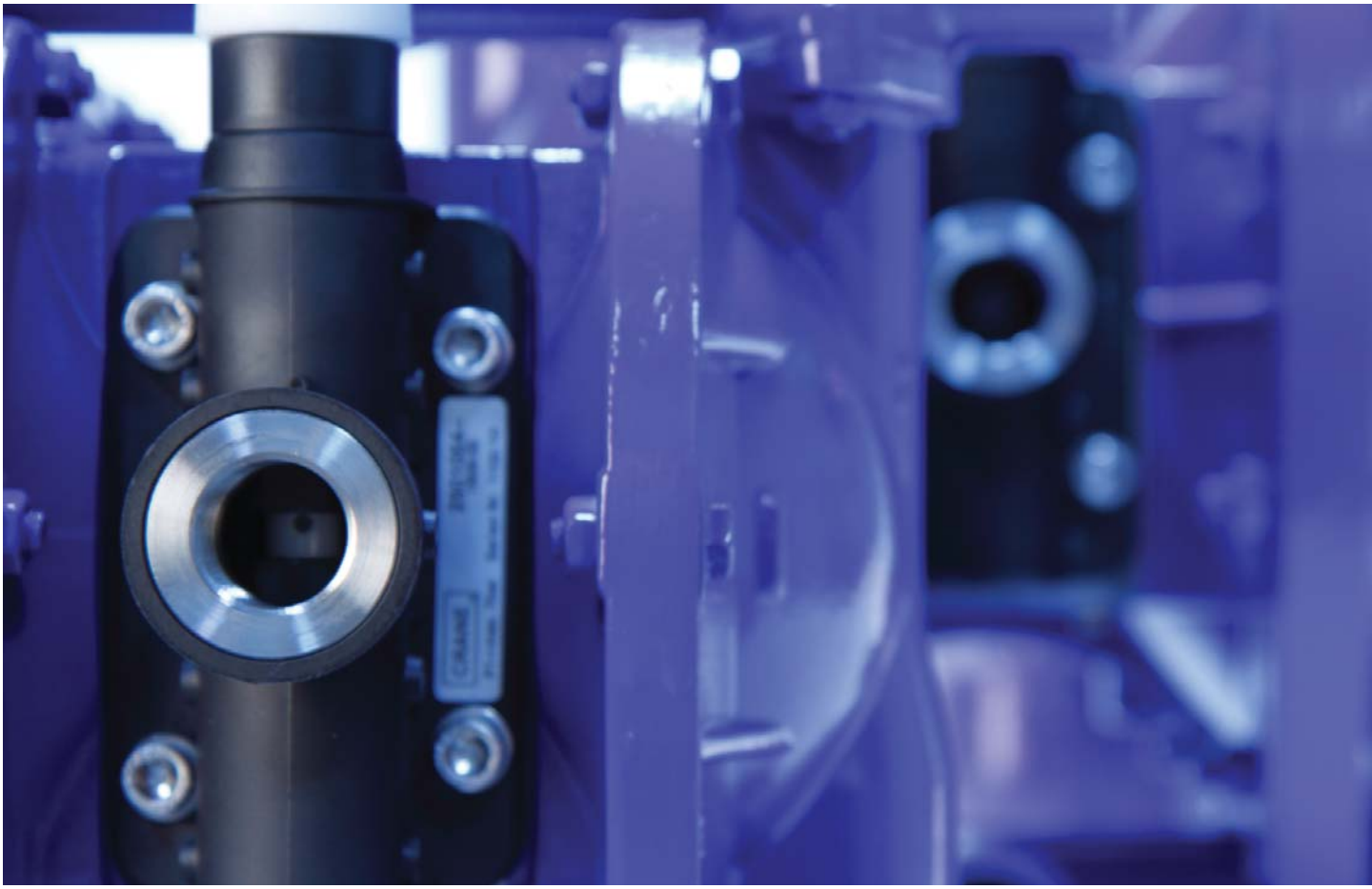
Making a case for the pump of



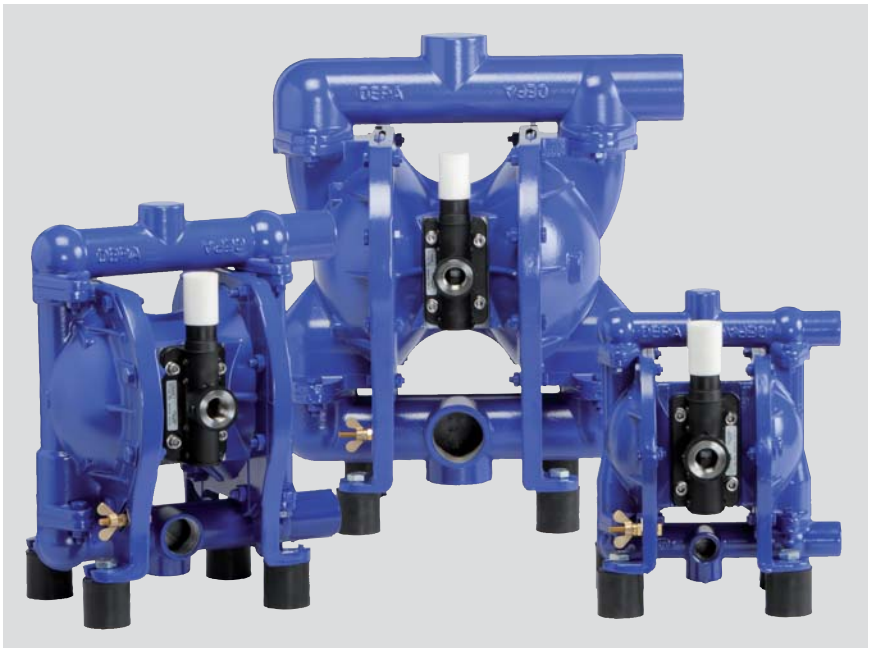
Thomas Walbröhl, a Pump Application Specialist at Crane ChemPharma & Energy delves into the unique capabilities of air-operated double diaphragm pumps and their ability to deliver solutions to a range of applications. With the ability to self-prime, accommodate highly-viscous liquids and suspensions, and meet the requirements of highly-demanding applications in volatile environments, AODD pumps exceed the needs of process engineers without compromising cost or safety. Customizable to address the pain points of customers spanning the industry, AODD pumps offer an alternative to more costly pump types and facilitate operations for engineers worldwide.

By Thomas Walbröhl, Pump Application Specialist, Crane ChemPharma & Energy

Forcing liquids, gases and slurries through mechanized systems worldwide, pumps are the driving force behind many modern industrial processes. From ponds to petroleum, mechanical pumps fuel a range of applications that depend on the effective, efficient displacement of fluids. The automotive industry utilizes pumps for water-cooling and fuel injection, while energy companies pump oil and natural gas, and operate cooling towers. Pumps extract water from wells, filter aquariums, and aerate ponds; they are used in biopharmaceutical applications to develop and manufacture medicine, and even act as artificial replacements for body parts. In short, pumps are essential in modern manufacturing, and their applications are as diverse as their assemblies.

Pumps are divided into two main groups: centrifugal or rotary pumps and positive displacement pumps. Whereas the former increases energy by means of exchanging impulses or momentum, the latter does so by means of an enclosed defined volume. Among the impulse pumps are centrifugal, rotary lobe and gear pumps, while the positive displacement pump group includes piston, hose and diaphragm pumps, each of which has a different application and mode of operation. This article will focus primarily on air-operated double diaphragm pumps and address how this particular pump type overcomes a variety of operational challenges.

all trades



AODD pumps have the ability to dry-run without causing damage to the pump. They are also able to transfer highly viscous liquids and solids, making them ideal for chemical applications.

Air-operated double diaphragm pumps

A diaphragm pump is a positive displacement pump that combines the reciprocating action of a rubber, thermoplastic, or Teflon diaphragm with suitable valves on either side to pump a fluid. Air-operated double diaphragm pumps offer users a number of benefits, including:

- Dry self-priming ability
- Damage-free dry running
- Damage free if the pump is run against a closed discharge valve
- Easily-adjustable variable flow from air supply
- Fluid path free of complex seals
- Low shear pumping
- Operation and maintenance friendly
- Able to transfer highly viscous liquids and solids
- Suits industrial, chemical, and hygienic fluid handling

With good suction lift characteristics and the ability to handle sludges and slurries with a relatively high amount of grit and solid content, AODD pumps are an effective solution for many of the challenges faced by users. The following paragraphs will explore three cases in which this pump type was able to span industries and fulfill customer needs.

Case # 1: Oil storage facility applications

Engineers at one of Europe's largest oil tank storage facilities were challenged with managing petrochemical spills and inflammable gases when their facility was deemed hazardous and shut down in 2012.

Containing nearly 300 tanks ranging in capacity from 735 to 40,000 cubic meters, the massive terminal serves a variety of transportation networks, including tanker traffic across the North Sea, road and rail networks to inland Europe and international pipeline networks. With a total capacity of 1.63 million cubic meters, the terminal lies at the heart of the Rotterdam petrochemical cluster and bears substantial environmental and safety responsibilities.

Under each tank at the facility, a sump collects both rain water and any waste liquid from spills. With the possibility of inflammable gases occurring in both the sump and collecting vessel, both areas were designated to ATEX zone 0 by the association of technical inspection, and the use of submersible centrifugal pumps was discontinued due to non-conformity to ATEX regulations. As a result of safety issues, the terminal was temporarily shut down in 2012, leaving engineers scrambling to find a pump that would conform to regulations and replace the centrifugal pumps upon which they had relied.

AODD pumps, not only offered a direct-replacement solution, but their ability to self-prime enabled them to be located in a more easily-accessible location adjacent to the tanks. The switch from costly, vertical centrifugal pumps to the air-operated double diaphragm pumps not only delivered substantial cost savings to the customer for each pump installation, but enabled the engineers to select alternative housing materials like aluminum and ductile iron, rather than a more costly stainless steel.

Air-operated double diaphragm pumps, therefore, not only increased site safety and met all requirements to restore terminal operations, but delivered significant cost savings and increased efficiency in the process.

For food processing engineers, highly-viscous solutions with various solid particles meant clogged systems, low quality and costly repairs.

Case # 2: Food industry

While few of the hundreds of thousands of consumers who enjoy chocolate-coated ice cream will give a thought as to how it's made, the challenge of achieving a consistent chocolate coating on frozen ice cream is of major concern to food processing engineers.

Containing additives like crushed almonds, coffee beans or caramel, these coatings produce a viscous and sticky solution that must be constantly heated and circulated to prevent the additives from dropping to the bottom of the holding container. Due to flow volume and velocity relative to pipe diameter, the solids tend to congregate and clog rotary lobe pumps, resulting in high investment and repair costs.

For engineers at a food processing plant in Heppenheim, Germany, the solution came in the form of customized 2" polished stainless steel AODD pumps with increased inlet and outlet manifolds to prevent the incoming product from clogging. Mounted on mobile frames with individual pressure regulators and integrated air hoses, the units can be flexibly used in different production lines and easily removed for cleaning.

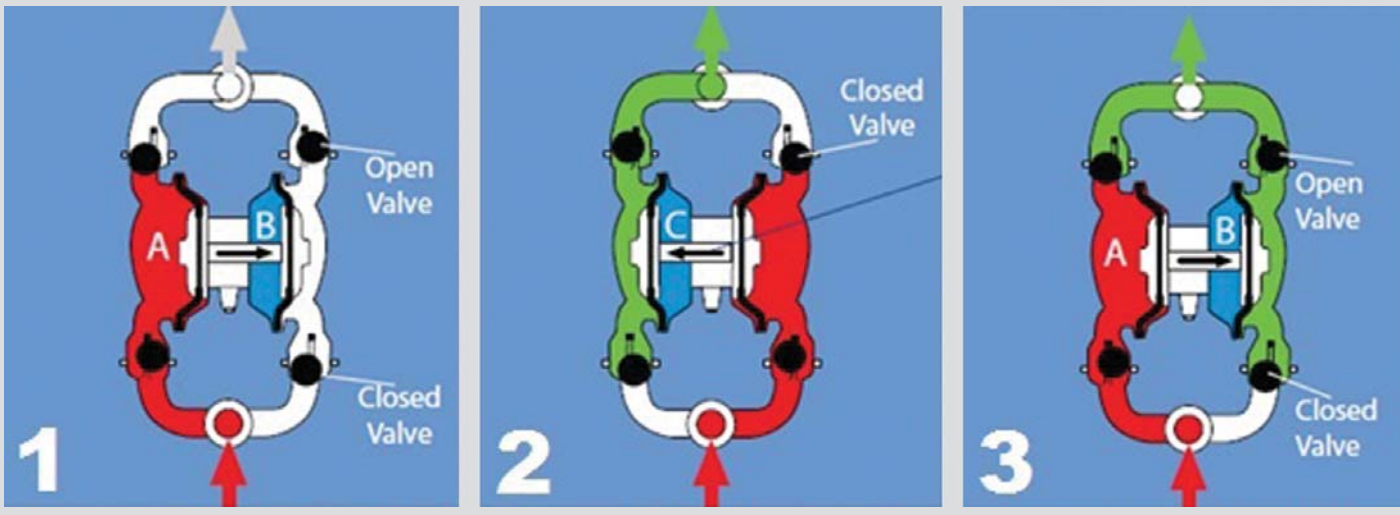
The AODD pumps allowed the mixture to be constantly and smoothly circulated at a slow speed, keeping the additives in permanent movement, and resulting in a homogeneous product mass. For emptying residue, the pump could be rotated in the frame, enabling the valves to open and freely drain. The mobile unit gave production staff the flexibility they required for different lines while helping to maintain vital product uniformity and dependable operation.

Case #3: Chemical industry applications

In highly-corrosive, erosive and hazardous environments, engineers struggle to protect against fugitive emissions and ensure flawless, leak-free operation.

In volatile chemical processes where hazardous fluids are handled, it is critical that the interfaces between pump aggregates, pipelines and the pumps themselves are well sealed to avoid the possibility of leakage. The most effective way to ensure that systems don't leak, of course, is to reduce the number of interfaces or eliminate them completely in pump design.

A large chemical company in Germany tested various PTFE AODD pump types to evaluate their performance and ease of operation in a pilot plant. After each fluid transport process, the pumps were disassembled and thoroughly cleaned to ensure that each component was residue free and ready for the next



On start-up, pressurized air in region B (acting via connected diaphragms) lowers the pressure in chamber A.

Pressurized air in region C acts on the diaphragm to displace product out of the pump.

Pressure is created in B, expels product, draws new product into A where low pressure area had been simultaneously generated.

Figure 1: Air-operated double diaphragm pumps use pressurized air to lower the pressure in nearby chambers, thus causing the product to be displa

fluid. After several disassembly and reassembly procedures, it was clear that pump types with multiple threaded plugs and PTFE components became quickly worn out and deformed in those specific areas. As a result, leakage-free sealing was lost and a complete replacement of expensive PTFE housing parts was necessary to ensure safe operation.

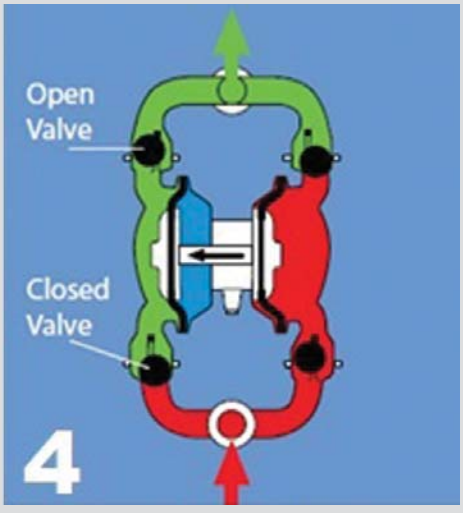
These problems can be solved by eliminating such thread-interfaces directly during the design process—simply said, if the interface is absent, no leakage can occur. After extensive research, the customer selected an AODD pump with no thread-equipped PTFE parts. The pump not only helped solve the problems associated with threading, but provided a closed-surface PTFE diaphragm without an additional outer piston for diaphragm fixing. By utilizing a thread-free AODD pump rather than an alternative pump type, the customer was able to reduce the safety concerns associated with fugitive emissions, as well as decrease maintenance and downtime costs by eliminating

For those transferring sludges, slurries, and a high amount of grit and solid content, AODD pumps offer a solution.

the need for frequent repair and replacement.

Selecting the correct pump size

Choosing the right pump size depends on the required flow rate and the back pressure of the system. Because the specifications for air-operated double diaphragm pumps are based on water, it is very important to account for fluid viscosity and suction lifts when determining the correct operating point of the pump. If the pump is used in continuous operation with a high driving pressure (for example, 7 bar), it is recommended to switch to the next size, which will reduce the driving pressure while maintaining the flow rate, reduce the number of strokes, and thus increase the lifetime of the diaphragm. Other criteria to consider during pump selection include material selection in abrasive or chemical applications, maximum temperature capabilities and environmental factors like radiation and convection. In hazardous areas, only pumps approved for use with the corresponding electrically-conductive housing material and suitable interior may be utilized.



The cycle repeats by alternately producing pressure in regions B and C while the pump is in operation.

ced and then expelled.

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