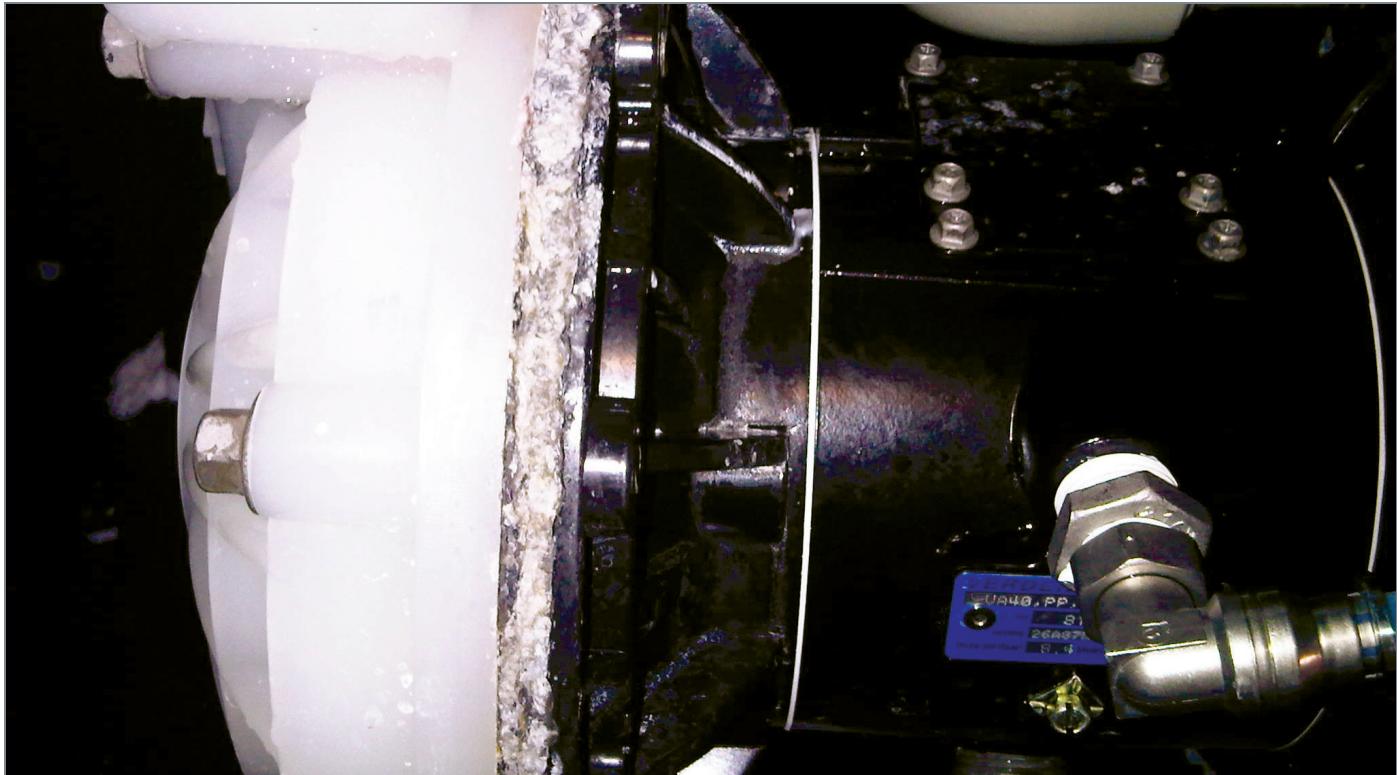


Advancing AODD Pump Design for Dangerous Chemicals

CONSIDER CHEMICAL COMPATIBILITY, CONTAINMENT AND ENERGY EFFICIENCY WHEN SELECTING AN AODD PUMP IN DANGEROUS CHEMICAL APPLICATIONS



The aluminum materials in this air-operated double-diaphragm (AODD) pump had corroded at the diaphragm, leading to an extremely dangerous situation where workers were at risk of exposure.

The chemical industry converts raw materials into 70,000 different products, but each chemical sub-sector presents its own unique challenges and dangers. Namely, each includes dangerous chemicals that are used in the production of tens of thousands of products. Dangerous chemicals require careful transfer and pump components to protect workers and the environment. When it comes to determining which pumping technology is best-suited for handling a dangerous chemical, there are numerous factors that must be taken into consideration.

Dangerous chemicals are those chemicals considered highly corrosive, toxic or potentially explosive. Chemical pesticides, for example, contain toxic chemicals that kill insects, fungus, bacteria and other things that feed on crops. Pesticides are also found in many common household products. In addition to pesticides, toxic chemicals are used in the production of many household items, such as furniture, electronics and even plastic toys.

Many of the most dangerous chemicals used in the chemical industry fall under the inorganics chemical subcategory. This

includes sulfuric acid, hydrochloric acid and phosphoric acid. In 2024, roughly 728,000 tons of sulfuric acid was produced in the United States. Nearly 75% of the sulfuric acid produced annually is used in the production of agricultural fertilizers. Other uses include production of dyes, alcohols, plastics, rubber, ether, glue, film, explosives, drugs, paints, food containers, wood preservatives, soap and detergents, pharmaceutical products, petroleum products, and pulp and paper.

Bulk industrial chemicals include those chemicals and materials that are produced in the chemical industry in large quantities. This includes petrochemicals, which are organic chemicals made from hydrocarbon raw materials sourced from crude oil, natural gas or coal. Dangerous aromatics such as benzene, toluene and xylenes — along with olefins such as ethylene, propylene and butadiene — are the primary building-block chemicals in the production of petrochemical intermediates and final products. Many dangerous petrochemicals are processed into polymers for use in plastics, resins, fibers, elastomers and coatings. Petrochemicals are also used to make a wide range of end-use products such as detergents, adhesives, solvents, plasticizers and lubricants.



A mag drive pump caused a fluid rupture in a hazardous chemical application, putting workers at great risk.

The Pump of Choice in Dangerous Chemical Handling

Pumps play a critical role in the handling and transferring of dangerous chemicals, as they are used throughout the chemical supply chain to transfer chemicals from the pipeline or bulk tank, to name a few applications. With multiple key transfer points in the process, it is crucial that manufacturers select the proper pump for their specific applications. When pumping dangerous chemicals, system designers and operators should consider the following:

- Chemical compatibility for all wetted parts
- Guaranteed leak-free operation
- Constant flow rates with no slippage
- Reliable operation in harsh conditions and atmospheres

The pumping technology that best meets all four criteria is AODD, or air-operated double diaphragm pump technology. AODD pumps are reciprocating, positive-displacement type pumps that only have a few wetted parts and are driven by an air distribution system rather than an electric motor. This allows AODD pumps to run dry and shut-off without damage, while their self-priming capabilities give AODD pumps superior suction lift over competitive technologies.

Competitive technologies like lobe and gear pumps have disadvantages that make them less reliable in handling dangerous chemicals. Lobe pumps, for example, are prone to friction wear and product slippage, which adversely affects flow rates and production volumes. With gear pumps, the meshing gears will begin to wear as soon as the pump is turned on. As gears wear, volumetric consistency is compromised, leading to reduced or inconsistent flow rates and increased energy consumption.

When compared to centrifugal and gear pumps, whose turbulence can damage the particulates present in certain chemical processes, AODD pumps provide a gentle pumping action. There is no friction, which eliminates the "shearing" that can damage or alter the chemical properties. AODD pumps also offer a variety of compatible materials of construction depending on the chemical being used. An important distinction is the design: by removing the need for mechanical seals, AODD pumps provide virtually leak-free product containment. Additionally, contrary to many pump technologies (especially centrifugals), AODD pumps are extremely flexible during operations as the same pump can be used for different flow rates and needs, just by adjusting the air supply.

The Wilden® Advantage

Not all AODD technologies are created equal and Wilden, the respected leader in AODD pumps ever since Jim Wilden invented the technology in 1955, is the superior dangerous chemical-handling option when compared to its AODD competitors. This is due to time- and field-proven performance, containment and maintenance advantages. Wilden AODD pumps offer a longer mean time between repair (MTBR), exceptional suction lift and self-priming capabilities (a critical aspect in transferring dangerous chemicals), and vast chemical compatibility, as well as the exclusive Pro-Flo® SHIFT Air Distribution System (ADS) that lowers energy consumption.

One reason Wilden pumps are superior in dangerous chemical applications is the wide range of models that are available, as well as their respective materials of construction. Wilden offers the widest range of polypropylene (PP) and polyvinylidene fluoride (PVDF) pumps on the market, as well as conductive PP and PVDF pumps certified to ATEX standards. Wilden's metal pumps, which include stainless steel, cast iron, aluminum and Hastelloy®, feature ATEX certification, which certify the pumps for use in explosive environments.

Another reason Wilden AODD pumps excel in chemical applications is the Chem-Fuse® Integral Piston Diaphragm (IPD). Its one-piece design provides greater durability, 2–15 times longer life by eliminating outer-piston abrasion and enhanced containment and safety by removing potential leak points. The easy-to-clean surface also allows for faster product changeovers.

Material Compatibility

Solvents can corrode aluminum or galvanized parts. If the wetted parts or a pressurizable fluid system contain aluminum or galvanized components, this corrosive action could cause an explosion. Although manufacturers of these solvents typically add corrosion inhibitors, there is no known inhibitor

that will prevent a corrosive reaction under all circumstances. Only stainless steel or PVDF pumps should be used for these materials, and Welden offers the widest range of PVDF and stainless steel pumping options for these types of applications.

Welden also features innovative diaphragms in various materials to meet any dangerous chemical pumping need. Diaphragm life varies depending on the abrasiveness of the fluid, temperature, size of the diaphragm, pumping media and lift conditions. Most dangerous chemicals cannot be handled with Neoprene or Buna-N and will require Wil-Flex™, Fluoroelastomer Rubber (FKM), EPDM (Nordel™) and/or polytetrafluoroethylene (PTFE).

- **WIL-FLEX™:** Made of Santoprene, this diaphragm is an excellent choice as a low-cost alternative to PTFE in many acidic and caustic applications, such as sodium hydroxide, sulfuric or hydrochloric acids. It exhibits excellent abrasion-resistance and durability at a cost comparable to Neoprene.
- **EPDM/NORDEL™:** Excellent for use in applications requiring extremely cold temperatures. EPDM may also be used as a low-cost alternative for pumping dilute acids or caustics.
- **Fluoroelastomer Rubber (FKM):** Excellent for use in applications requiring high temperatures. FKM may also be used with aggressive fluids, such as aromatic and chlorinated hydrocarbons and acids. PTFE would normally be used with these aggressive fluids as its flex life is better than FKM. However, in applications involving suction lift outside the range of PTFE, FKM will be the preferred choice for highly aggressive fluids.

The ATEX Directive



The ATEX directive was implemented within the European Union in 2006. While it is only required in the EU, it is widely recognized as the most important global symbol for equipment safety. ATEX derives its name from the French title of the 94/9/EC directive *Appareils destinés à être utilisés en ATmosphères EXplosives*.

ATEX has two parts: ATEX 95, also known as the Product Directive, ensures that equipment is suitable for use in hazardous areas and meets applicable standards. ATEX 137, the Worker Protection Directive, concentrates on the duties of the end-user, ensuring that equipment and facilities are managed responsibly when in use.

Advanced Containment

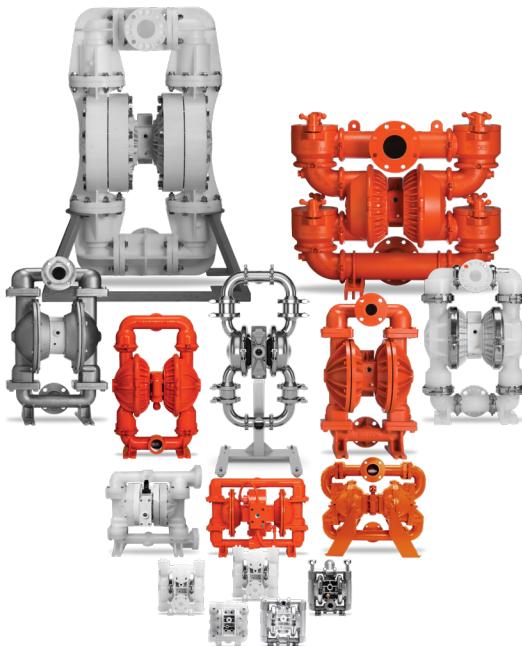
Wilden Pro-Flo® SHIFT Series Metal and Plastic Bolted AODD Pumps are specifically designed for maximum performance, efficiency and containment. The bolted configuration ensures product containment, while the absence of a mechanical seal or packing reduces the risk of leaks and pump failure. Another containment feature is Wilden's integral piston diaphragm. Most AODD pumps offer multiple-piece diaphragm configurations, but Wilden's integral piston diaphragms are single-piece design, which eliminates any potential leak points.



AODD pumps feature strong suction and can provide a "dry prime" by drawing fluid from tanks no matter the location.

Increased Efficiency

Wilden Pro-Flo SHIFT Series Pumps are equipped with the patented Pro-Flo SHIFT ADS, designed to limit the air flow into the air chamber as each pump stroke approaches completion. This ensures that just the right amount of air is introduced to maintain the pumping process. This efficient design automatically optimizes air consumption and prevents overfilling of the air chamber, all while maintaining the flow rate. This results in pump operation that is the most efficient and cost-effective in the industry. It also features full-stroke PTFE diaphragms that provide increased product displacement per stroke, resulting in greater flow rates and higher efficiencies when compared to pumps that rely on reduced-stroke PTFE diaphragms. A "drop-in" design allows the pump to be installed into an existing pump footprint without the need to disturb the piping, resulting in reduced maintenance costs and system downtime.



Conclusion

In 2024, the global chemicals industry market size was valued at nearly 6 trillion. In the United States, the chemical industry accounted for approximately 10% of all exports. In the European Union, chemicals accounted for 17.6% of all extra-EU trade (both imports and exports). By 2029, global chemical industry sales could reach over 7 trillion.

The chemical industry continues its growth trend after the economic downturn of 2008. Chemical manufacturers continue

to increase capital spending. But that growth is being met by increased legislation and regulations, which are putting greater demands on manufacturers to safely protect the environment and consumers, as well as their own workplaces. Therefore, manufacturers must eliminate the dangers involved with handling high-risk chemicals such as acids, caustics and solvents. Incorporating pumping solutions like the time-tested AODD technology that has been offered by Wilden to the chemical industry for more than 70 years helps deliver the peace of mind that is a critical priority in both the short- and long-term.

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