

# Air-Operated Diaphragm Pumps in Modern Process Plants

A look at the evolution, applications and benefits of AODD pumps.

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In the realm of chemical process manufacturing, pumps do not just move fluids—they move the entire industry forward. As chemical formulas grow more complex and markets demand faster, cleaner and safer production, the importance of choosing the right pump has never been greater.

Among the technologies available, air-operated double-diaphragm (AODD) pumps offer a versatile and reliable option for processing a wide range of process fluids.

## Shifting Paradigm: A New Age of Chemistry

Today's chemicals are rarely just corrosive or flammable, but often a multifaceted mix: toxic, viscous, abrasive, with suspended solids and sensitive to temperature and shear, often all at once. This has left engineers and process designers grappling with the necessity of a versatile pump to handle these complex chemicals. Many users experiment with various pump technologies and end up learning through costly trial-and-error experiences. Although many technologies excel under specific conditions, AODD pumps are among those that combine versatility, safety and reliability.



IMAGE 1: Biocide paint applied using a 1-inch AODD pump (Images courtesy of SAMOA Industrial)

## The Evolution of Diaphragm Pumps

Originally invented for slurry and mud applications, AODD pumps have evolved substantially over the past decades. Early developments included material upgrades in alternative wetted materials (e.g., polytetrafluoroethylene [PTFE], polyvinylidene fluoride [PVDF], stainless steel) and elastomers to match a wider range of fluid chemistries. Later, the mechanical design enhancements followed, such as bolted housings, for leak-proof reliability. Subsequently, manufacturers started developing specialty models tuned for solids handling, powder handling, submersible use, clean-room use, high-pressure applications and high-purity processing.

Over time, attention shifted toward energy efficiency. The latest advancements include high-efficiency air valves for reduced air consumption and dampening technologies to reduce pulsation and noise, aligning pump performance with modern expectations for precision and sustainability. But evolution did not stop there.

## The Rise of Electric Diaphragm Pumps

In response to rising energy demands and sustainability goals, the industry birthed the electric-operated diaphragm pump (EODD), and these pumps have garnered a lot of interest in recent times. They provide diaphragm pump versatility with electrical precision, along with lower energy consumption, reduced noise and programmable flow control.

While these features address emerging operational and regulatory priorities, EODD pumps introduce trade-offs as well. EODD systems often feature complex mechanics, higher installation costs and less flexibility when compared to their air-operated counterparts. Furthermore, mechanical actuation can introduce uneven stress distribution on diaphragms, potentially reducing service life. They are sometimes complex to maintain, require explosion-proof setups and struggle with super-corrosives or dry-run conditions.

## AODD vs. EODD: Complementary, Not Competitive

EODD pumps serve well:

- Where compressed air is not available
- Where precision flow control is paramount
- In quiet, continuous-duty environments

But for dynamic, multipurpose or hazardous applications, AODD pumps are often a better choice due to their portability, chemical compatibility and reliability.

## Why AODD Pumps Remain Core to Process Flexibility

At first glance, AODD pumps are delightfully simple. But these pumps are inherently suited to handle complex process conditions and deliver on multiple fronts:

- No electricity is required, making them intrinsically safe for explosive zones.
- They are able to handle nearly any fluid, from acids to sludges to solvents.



IMAGE 2: Fire retardant treatment for wood using a 2-inch AODD pump

- They are dry-run capable and self-priming, with high tolerances to clogging and cavitation.
- There is no heat transfer, ensuring thermal stability for sensitive chemicals.
- They tolerate dry-run conditions without damage.
- They are able to manage a wide spectrum of viscosities and solids contents.
- They offer simple maintenance with minimal downtime.

This versatility makes them useful in process facilities where fluid characteristics may vary between batches—or even within the same process stream.

## Critical Applications: AODD in Action

AODD pumps find practical use at nearly every stage of chemical production. Key applications include:

1. **Raw material unloading:** Used to transfer chemicals from road tankers to storage or day tanks, AODD pumps can accommodate variable fluid types without critical size calculations or expensive motor drives. Their ability to dead-head against closed valves

without damage eliminates the need for additional safety systems like pressure relief valves or bypass systems.

2. **Pretreatment and conditioning:** When feeding fluids, slurries or powder-liquid blends to grinders, filters or heaters, AODD pumps can respond to varying back pressures and flow demands naturally, making them well-suited for on-demand operation during blending, heating or milling.
3. **Reactor feeding and low-pressure dosing:** Thanks to consistent volumetric displacement per stroke, AODD pumps can be effective for feeding additives, catalysts or pretreated media into reactors. They can tolerate elevated temperatures and aggressive chemistries without compromising fluid integrity or reactor balance.
4. **Separation and purification:** Whether reclaiming solvents, recovering intermediates, extracting byproducts, removing solids or purifying or filtering the final product, AODD pumps can perform these tasks without compromising purity or system equilibrium.
5. **Recirculation:** To prevent settling or phase separation and to maintain homogeneity and avoid degradation, AODD pumps are used for the recirculation of intermediate products, especially for viscous or temperature-sensitive batches.
6. **Sampling and quality control:** Compact AODD units can provide clean, reliable sample retrieval from tanks or process lines for lab analysis, ensuring quality standards are met without disrupting process continuity.
7. **Filling and packaging:** AODD pumps handle high-purity and shear-sensitive fluids well, transferring the final product without foaming or froth. They can be gentle and precise and preserve product quality. Their nonheating action helps maintain the thermal and chemical integrity of final products.
8. **Loading for dispatch:** With adjustable flow rates via simple air regulation, these pumps can fill containers,

intermediate bulk containers (IBCs) and tankers with optimal speed and control.

9. **Waste and sludge disposal:** Process waste—often containing solids, sludges, slurry or corrosive residues—can be transferred safely and efficiently using AODD pumps, including from underground pits or mobile containers, without priming or cavitation.

## Balancing Innovation With Practicality

As the world moves toward net-zero operations and digital integration, pump selection is more than a spec—it is a strategy. Sustainability goals should be pursued in tandem with pragmatic engineering.

While energy efficiency is vital, it must not come at the expense of maintainability, reliability or total cost of ownership. Technologies that perform admirably on technical data sheets may prove operationally burdensome if they lack serviceability or adaptability.

For many process plants, a hybrid approach delivers the most robust and cost-effective results, deploying AODD pumps in high-risk or flexible zones or for intermittent duty applications and EODD pumps in stable, power-available environments, where continuous duty is demanded.

The continued relevance of AODD pumps in modern chemical facilities lies in their balance of simplicity, safety and versatility. As manufacturers pursue digitalization, cleaner technologies and operational efficiency, AODD pumps remain a dependable cornerstone in fluid handling strategy. They are optimized solutions for the evolving demands of the present and future. ■

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