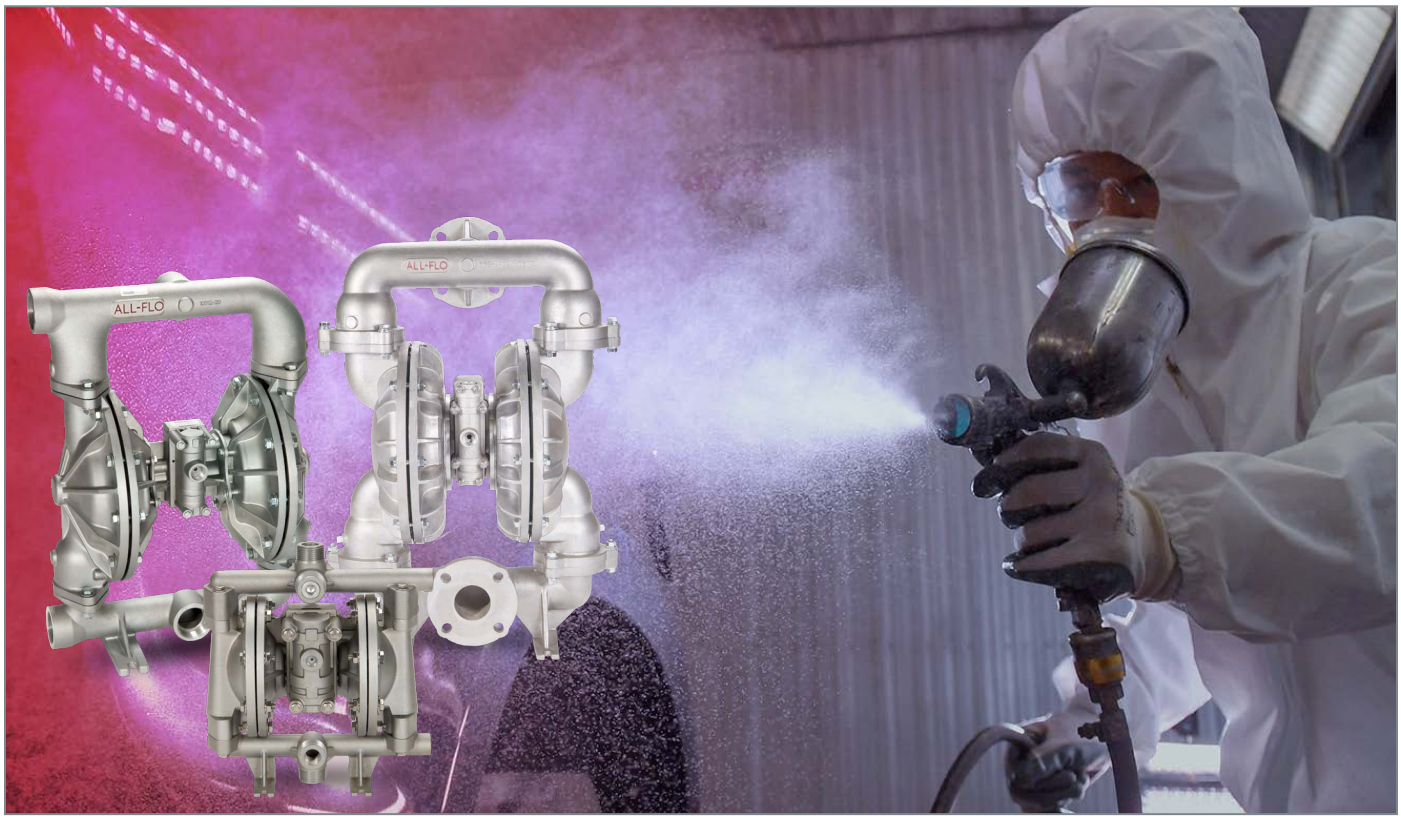
Solving Fluid Transfer Challenges in Modern Paint and Coatings Manufacturing

HOW AODD PUMPS PROVIDE MATERIAL COMPATIBILITY, FLUID-HANDLING FLEXIBILITY AND RELIABLE OPERATION NEEDED TO PROTECT FORMULATIONS AND MAINTAIN THROUGHPUT

By: Sam Gilbert



Introduction

Paints and coatings often goes unnoticed when it performs well. It protects bridges from corrosion, shields pipelines from chemical attack, preserves food-processing equipment and defines the visual identity of homes. Yet behind every coated surface is an engineered formulation and a manufacturing process that demand precision and reliability. Each gallon produced must deliver consistent performance under environmental stress, mechanical wear and regulatory scrutiny.

What appears simple on the surface is a complex balance of chemistry, process control, and equipment reliability that works together throughout the formulation and production stages of modern paint and coatings manufacturing. Achieving that balance requires more than carefully selected raw materials. It depends on the consistent movement, blending and transfer of highly varied fluids, from pigments and resins to solvents and additives.

Within these increasingly demanding processes, fluid-handling systems play a critical role in maintaining both product quality and production efficiency. Pump technology, in particular, must handle abrasive solids, shear-sensitive materials and varying viscosities while supporting safe, efficient and reliable operation.

This white paper explores the operational challenges facing paint and coatings manufacturers and how air-operated double-diaphragm (AODD) pumps can offer the material compatibility, fluid-handling flexibility and reliable performance needed to safely and efficiently transfer formulations, while maximizing uptime and throughput.

Industry Overview and Market Trends

The global paint and coatings market continues to expand as infrastructure development, urbanization and manufacturing output increase worldwide. Industry analysts projected that the global market reached approximately $193 billion in 2025 and would grow at a compound rate of about 4.2% through 2035.

Asia-Pacific remains the largest regional market, accounting for roughly 40% of global demand, driven largely by construction

growth and industrial expansion in China and India. North America and Europe continue to lead in the development of high-performance coatings, supported by strong environmental regulations and advanced manufacturing sectors.

Market composition is also shifting. Waterborne coatings now represent more than half of global demand, particularly in architectural applications, as manufacturers work to reduce volatile organic compound (VOC) emissions and improve workplace safety. At the same time, solvent-borne coatings remain essential in industrial, marine and protective applications where durability, chemical resistance and environmental performance are critical.

These trends are driving ongoing innovation in paint and coating formulations. New materials and higher solids content improve durability and environmental performance but also increase manufacturing complexity. As a result, process equipment must adapt to handle a broader range of viscosities, solids content and chemical properties.

Key Operational Challenges in Coatings Manufacturing

While the paint and coatings market continues to grow, manufacturers must manage a range of operational and regulatory challenges that affect production efficiency and product quality.

Raw Material Volatility

Fluctuations in petrochemical feedstocks and pigments such as titanium dioxide make cost forecasting difficult and place pressure on manufacturing efficiency.

High-Viscosity and Abrasive Formulations

Modern high-solids coatings and architectural paints often contain dense pigment loads and fillers. These abrasive materials can accelerate wear in conventional pump technologies, increasing maintenance requirements and downtime.

Environmental and Regulatory Compliance

Tightening environmental standards from agencies such as the Environmental Protection Agency (EPA) require manufacturers to continually reformulate products to reduce VOC emissions, reduce allowable leakage of product and eliminate hazardous substances.

Product Stability

Waterborne coatings and advanced formulations can be sensitive to shear, temperature changes and air entrainment. Improper handling during transfer can destabilize emulsions, introduce foam or alter desired fluid properties.

Sustainability Pressures

Manufacturers are increasingly expected to reduce waste, minimize emissions and lower the carbon footprint of production operations. Improving energy efficiency and reducing product loss during transfer are important contributors to these goals.

Addressing these challenges requires process equipment that can reliably handle diverse formulations while maintaining consistent product quality and operational safety.

Paint and Coatings Formulation

While paint is often associated with color and appearance, coatings serve a wide range of protective and functional roles. They can inhibit corrosion, resist chemicals, protect surfaces from moisture and ultraviolet radiation, and improve sanitation in industrial environments.

Most paints and coatings consist of four primary components: binders, carriers, pigments and additives. Binders form the durable film that adheres the coating to the substrate and determine many key performance characteristics such as adhesion strength, flexibility and chemical resistance. Water or solvent acts as the carrier, controlling viscosity and allowing the coating to be applied as a liquid. Pigments provide color, opacity and additional functional properties, while additives fine-tune performance characteristics, including dispersion stability, foam control and consistency.

Paints and coatings generally fall into two broad categories. Waterborne systems use water as the primary carrier and have grown rapidly due to environmental regulations and requirements to reduce VOC emissions. Solvent-borne systems remain widely used in industrial environments where durability, corrosion protection and chemical resistance are critical.

Because these formulations can be extremely complex and sensitive, their stability depends heavily on how materials are handled during production. Excessive shear, contamination or air entrainment can destabilize emulsions, damage pigment dispersion, or alter consistency. As a result, fluid-handling equipment plays an important role in maintaining formulation integrity throughout the manufacturing process.

Where Pump Technology Impacts the Process

Fluid transfer occurs throughout paints and coatings manufacturing, making pump technology a critical component of process reliability. Typical pumping applications include:

- Raw material unloading
- Pigment paste transfer to dispersion equipment
- Batch transfer between mixing tanks
- Let-down and additive dosing
- Packaging and container filling

These operations often handle materials with wide viscosity ranges, abrasive pigments and shear-sensitive emulsions. The pumps must also be capable of safely managing flammable solvents and ensuring containment in regulated environments. Selecting the wrong pump can introduce air into the product, damage pigment dispersion, or cause accelerated equipment wear. Over time, these problems can result in inconsistent product quality, higher maintenance costs and unforeseen production downtime.

In these crucial paint and coatings processes, selecting the appropriate pump technology directly contributes to maintaining both product quality and operational efficiency.

Evaluating Pump Technologies for Coatings Applications

Several types of pumps are commonly used in paint and coatings manufacturing, each with strengths and limitations depending on the application.

Air-Operated Double-Diaphragm Pumps

AODD pumps use two diaphragms to shift the air supply from one liquid chamber to the other. This design provides gentle, low-shear product handling and the ability to move fluids with a wide range of viscosities and solid content. Because they do not rely on mechanical seals, seal-less AODD pumps also reduce the risk of leakage when handling materials. Additionally, AODD pumps offer simple installation and lower upfront and maintenance costs compared to other pump technologies.

Centrifugal Pumps

Centrifugal pumps use a rotating impeller to generate a force that moves fluid. They are widely used for transferring large volumes of low-viscosity liquids. While efficient in high-flow applications, they can struggle with thicker formulations and abrasive pigments, which may increase wear and maintenance requirements.

Gear Pumps

Gear pumps are positive displacement pumps that move fluid through rotating meshing gear teeth and a casing. These pumps provide consistent flow and are often used in metering or controlled delivery applications. However, they are sensitive to solids and abrasive materials, which can damage internal components over time.

Eccentric Disc Pumps

Eccentric disc pumps have a cylinder and a pumping element on an eccentric shaft that rotates, forming a chamber that increases at the intake port to draw in fluid. These pumps handle moderate viscosity fluids with relatively low shear. In applications with abrasive fillers or pigments, internal wear may occur.

Progressive Cavity Pumps

Progressive cavity pumps use a single-helix rotor inside a double-helix elastomer stator to create moving cavities, allowing smooth, consistent movement of viscous materials. However, because their rotor-stator design can be susceptible to abrasion, these pumps typically require careful monitoring.

Comparative Chart

Attribute	AODD	Centrifugal	Gear	Eccentric Disc	Progressive Cavity
Gentle Handling	Excellent	Moderate	Moderate	Very Good	Excellent
Dry Run Capability	Excellent	Poor	Poor	Good	Poor
Solids Handling	Very Good	Limited	Limited	Good	Excellent
Viscosity Range	Wide	Best for Thin Fluids	Moderate	Moderate	Best for Thick Fluids
Deadhead Capability	Excellent	Poor	Poor	Poor	Poor
Mobility	High	Moderate	Moderate	Moderate	Moderate

How All-Flo™ AODD Pumps Address Industry Demands

Just as paint and coatings operations vary widely in their processes and formulations, AODD pump technologies differ in their design and performance. Among the many options, AODD pumps from All-Flo, a brand of PSG, a Dover company, have become a reliable choice across the paint and coatings industry.

Simplified Air Valve Design

At the core of the All-Flo pump is a seal-less design with a simplified air valve system with fewer moving components. By reducing internal wear points and eliminating many of the seal failures associated with mechanically sealed pumps, this configuration helps extend service intervals and improve overall performance. All-Flo also uses the same simplified air valve design across its product line, making it easier to maintain pumps of multiple sizes.

Material Compatibility

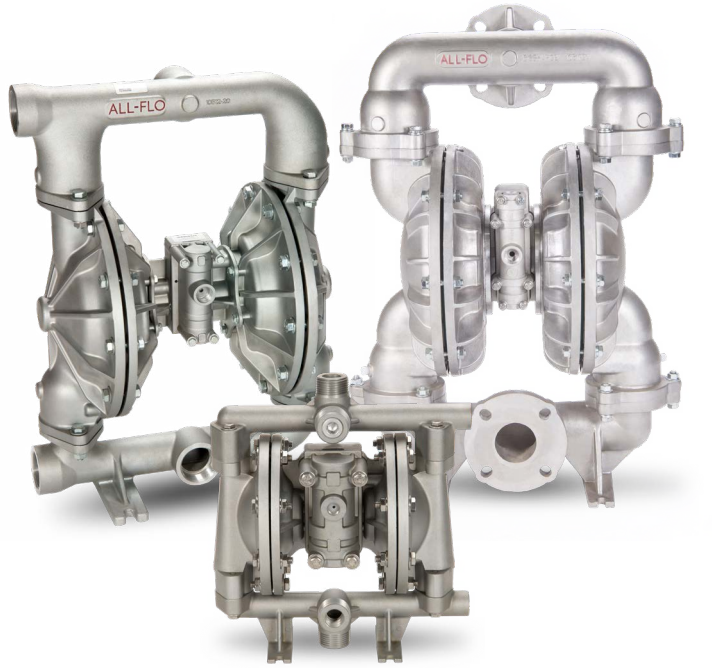
Resins, pigments, solvents and additives may all introduce compatibility considerations for fluid-handling equipment. All-Flo AODD Pumps are available in a variety of material configurations to accommodate these differences. Aluminum pump bodies paired with Santoprene® elastomers are commonly used in waterborne coatings and general industrial formulations. For more aggressive chemistries or solvent-heavy formulations, PTFE diaphragms provide enhanced chemical resistance and extended service life.

Handling Abrasive Pigments and Solids

Abrasive particles such as titanium dioxide, calcium carbonate and silica can accelerate degradation in pump components designed with tight tolerances or high rotational speeds. However, the operating principle used in AODD pumps allows fluid to move through the pump without high-speed rotating elements, reducing mechanical stress on both the pump and the coating formulation. For applications that involve larger solids or dense pigment loads, the All-Flo Max-Pass® Series AODD Pump is engineered to allow larger particles to pass through the pump with less restriction. This capability helps reduce the risk of clogging and supports more reliable transfer of high-solids coatings, high-solid-concentration coatings, pigment slurries and filler-rich formulations.

Operational Stability

While diaphragm pumps naturally produce a pulsating discharge flow, All-Flo offers optional pulsation dampeners for applications where smoother flow improves process control. These dampeners can prove essential during packaging operations, where consistent flow improves fill accuracy and minimizes foaming. By stabilizing discharge flow, dampeners can also help protect downstream equipment and support more consistent batching or container filling operations.



Safety in Hazardous Environments

Many coating formulations contain flammable solvents or produce vapors that require careful handling. Maintaining containment integrity during fluid transfer is therefore an important safety consideration in coatings production environments. All-Flo AODD Pumps in bolted pump construction help strengthen structural integrity and reduce the risk of leaks during these processes. For facilities operating in potentially explosive atmospheres, All-Flo offers ATEX-rated AODD pumps to support safe handling of flammable coatings and solvents in hazardous areas, protecting product, operators and the facility.

Application Flexibility

Pump sizing also plays an important role in optimizing plant efficiency. In many facilities, the 2-inch All-Flo AODD Pump can provide a practical balance between transfer capacity and equipment footprint. Pumps in this size range are commonly used for moving coatings between mixing vessels, intermediate storage tanks and packaging lines. For smaller-scale operations such as raw material transfer or drum unloading, compact pumps can provide greater flexibility. The ½-inch All-Flo AODD Pump is suitable for these applications and can be paired with drum kits designed specifically for container-to-process transfer. All-Flo pumps are also capable of running dry and self-priming without damaging the pump, adding to the flexibility of installation throughout the plant.

With a variety of materials, sizes and optional accessories, All-Flo AODD Pumps can support a wide range of coatings manufacturing processes while ensuring product quality, operational reliability and process safety.

Conclusion

Paint and coatings manufacturers operate in an increasingly demanding environment defined by evolving formulations, stricter environmental regulations and rising expectations for product performance. Meeting these challenges requires fluid-handling systems that can preserve product integrity while supporting efficient, reliable production.

AODD pumps offer several advantages for coatings manufacturing, including seal-less containment, gentle product handling and the ability to accommodate a wide range of viscosities and solids content. These characteristics help protect formulation stability while reducing the risk of leaks, downtime and maintenance issues.

By selecting pump technologies designed to meet the specific demands of coatings production, manufacturers can improve process reliability, enhance plant safety and support long-term operational efficiency in an increasingly competitive industry.

About the Author:

Sam Gilbert is a Product Manager for All-Flo. He can be reached at samuel.gilbert@psgdover.com. All-Flo is a product brand of PSG, a Dover company, Downers Grove, IL, USA. PSG is comprised of several leading brands, including Abaque, All-Flo, Almatec, Blackmer, Ebsray, em-tec, Griswold, Hydro, ipp, Malema, Mouvex, Neptune, PSG Biotech, Quantex, Quattroflow and Wilden. PSG products are manufactured on three continents – North America, Europe and Asia – in state-of-the-art facilities that practice lean manufacturing and are ISO-certified. PSG is part of the Pumps & Process Solutions segment of Dover Corporation. For additional information on PSG, please visit psgdover.com. PSG: Where Innovation Flows.

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all-flo.com

PSG
22069 Van Buren Street
Grand Terrace, CA 92313-5607 USA
T: (909) 422-1730 / F: (909) 783-3440

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