

High-Pressure Pumps in Paint & Coatings Operations

WILDEN® ADDRESSES THE CHALLENGES INHERENT IN PUMPING MODERN-DAY BINDERS, SOLVENTS AND ADDITIVES WITH ITS HIGH-PRESSURE SERIES METAL AODD PUMPS



Introduction

At their most basic, paint and coatings can be defined as “a group of emulsions consisting of pigments suspended in a liquid medium, such as oil or water, for use as a decorative or protective coating.” That rudimentary definition would have sufficed until the last 60 years or so, but things have drastically changed since then.

The major changes that have occurred in the paint and coatings industry since the 1970s have been paced by the introduction of new coating technologies, which have replaced traditional low-solid, solvent-based formulations. Today, synthetic pigments and stabilizers are used to mass-produce uniform batches of paint. Alkyd resins have become a major component within the production process. Sand mills and high-speed dispersion mixers are used to rapidly grind dispersible pigments. The growing demand for radiation-curable coatings, known as RAD Cure, powder-coating and nanotechnology increases demand for more environmentally safe, solvent-free and fast-drying paint and coatings.

In other words, the modern-day world of paint and coatings bears little resemblance to the days when cavemen used primitive ingredients to construct the “paints” that they used to adorn their cave walls.

According to Data Bridge Market Research, the global paint and coatings market is anticipated to reach nearly 284 billion by 2032 (4.01% CAGR). Helping create this growth will be next generation paint and coatings formulations that incorporate all of the available new technologies. These technologies rely on

a wide array of new feedstocks, chief among them being binders, solvents and additives.

This white paper will highlight a specific type of pumping technology—positive displacement air-operated double-diaphragm (AODD)—that offers the operational characteristics and reliability, especially in high-pressure transfer of binders, solvents and adhesives.

The Challenge

In 2011, Coatings World produced a series of articles that addressed the growth potential of the binder, solvent and additive markets within the Paint & Coatings industry. Among the magazine’s conclusions for the specific feedstocks were:

- **Binders.** Expect the steady growth that began in 2010 to continue. This growth will be sustained by an increase in the number of new infrastructure projects, from bridges to oil-and-gas pipelines; a strong automotive industry; and the continued growth of demand in emerging regions such as China, Brazil, India and Thailand.
- **Solvents.** Demand in the United States will grow in volume from \$39.6 billion in 2025 to \$52.4 billion by 2031, at a CAGR of 4.8%. This growth will be driven by a rebound in the demand for paint and coatings in the construction market. An increase in the number of regulations aimed at reducing volatile organic compound (VOC) emissions will drive the market for so-called “green” solvents that are more environmentally friendly.

- **Additives.** Fueled by a market shift toward water-based systems and rising demand from the Asia-Pacific region, the global additives market is projected to grow from \$9.12 billion in 2025 to \$10.97 billion by 2030, at a compound annual growth rate (CAGR) of 3.76%. Rheology modifiers and biocides will be the drivers of this global growth.

The overriding challenge, then, for producers of paint and coatings is to meet the growing demand while doing so in the most energy-efficient, environmentally sensitive and bottom-line friendly way possible. That's where identifying the proper pumping technology for the various components in paint and coatings manufacture comes into play.

Binder

The binder is the most important component of the paint. A binder is the liquid resinous part of a paint that holds all of the paint's constituents into a solution that, after application onto a surface, enables the paint to cure into a film. Binders "bind" the pigment together, providing adhesion, integrity and toughness to the dry paint film. With no pigment present, most binders would dry to form a clear, glossy film. Some binders are intentionally used without pigments to make clear finishes and varnishes.

The resinous material in binders is made up of polymers. A polymer is a chain linkage of many repeating individual chemical structures. The polymers used in binders tend to be highly viscous and therefore are generally thinned with solvent. The solvent-thinned polymers are termed "vehicles." A paint and coatings manufacturer will usually buy a binder polymer material that is already in vehicle form. The many types of film-forming polymer resins used in binders include acrylics, alkyds, aminoplasts, cellulose, epoxies, chloro- and fluorocarbons, natural plant oils, phonetics, polyesters, polyurethanes, silicones and vinyls.

Solvents

A liquid—also called the "carrier"—is the portion of the paint that provides a medium to get the pigment and binder from the container onto the surface that is to be painted. A solvent is a liquid that is able to lower the viscosity of a binder sufficiently to allow application onto a substrate and then evaporate to permit the formation of a paint film. A "true solvent" can dissolve and rapidly reduce the viscosity of the binder. Within limits, a "diluent solvent" is able to reduce viscosity, but it simultaneously weakens the solvent power of the true solvent. Various solvents can function as true solvents or diluents, depending on the particular type of binder (resin). The terms "thinner" and "reducer" are inexact and refer to any liquid used in mixing paints.

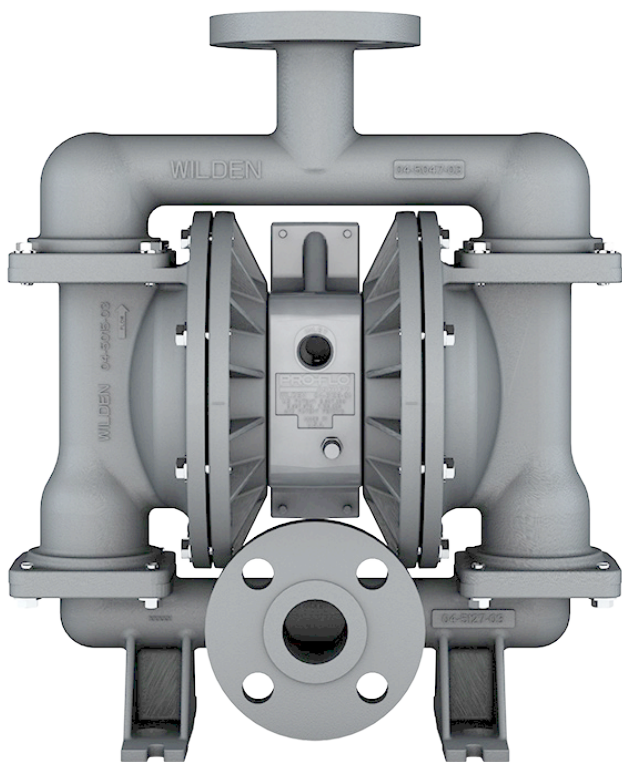


Additives

Additives are defined as low-level ingredients that provide specific paint properties, such as mildew resistance, defoaming, and good flow and leveling. A list of common additives used in the manufacture of latex paints includes:

- **Thickeners/Rheology Modifiers:** Provide viscosity so that the paint may be applied properly, impact how thick the paint is applied and how well it flows when applied
- **Surfactants:** Specialized soaps that stabilize the paint so that it will not separate or become too thick to use
- **Biocides:** Keep bacteria from growing in the paint and discourage mildew from growing on the paint's surface after it has been applied
- **Defoamers:** Break bubbles that are formed in the paint when it is mixed in a factory, stirred or applied to the surface
- **Co-Solvents:** Aid the binder in forming a good film when applied and enhance brushing properties, including the "open time" before it sets

Not only do each of these specific paint and coatings feedstocks have their own unique handling characteristics, they also require the need to be transferred at various points within the production cycle, for example, out of a storage tank or into a mixer. This requires pumping technology that is versatile enough to handle the transfer of binders, solvents and additives, oftentimes in high-pressure pumping applications. Additionally, given the wide range of dynamic head pressures that are created due to the variety of viscosities handled and the number of discharge points within the production process, an AODD pump can often represent



Wilden® HS430S 1-1/2" (38mm) Pump



Wilden® H800 2" (51mm) Duplex Pump

the best alternative in generating and meeting high-pressure requirements, which will also eliminate the need for intermediate transferring and ancillary distribution tanks.

The Solution

While many pump technologies have been tried in paint and coatings applications, most have been found wanting when handling binders, solvents or additives. However, AODD pump technology, which was invented in 1955 by Jim Wilden, the founder of the Wilden® Pump & Engineering Company, LLC, in Grand Terrace, CA, USA, has been proven to excel when handling these paint components.

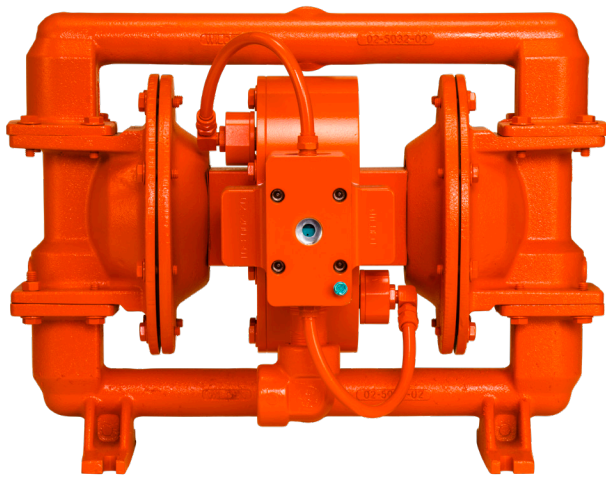
The particular pump that sets the standard in these operations is the High-Pressure Series AODD Metal Pumps. These pumps are ideal for binder, solvent and additive transfer because they feature a sealless, bolted configuration that ensures total product containment, while the design of the wetted path reduces internal friction, enabling the pump to deliver the level of shearsensitive operation that is mandatory when working with these components. The AODD pump's positive displacement operating principle also guarantees that the product flow rate will remain volumetrically consistent.

Wilden also has addressed the high-pressure pumping requirements that binders, solvents and additives can require with the creation of a family of High-Pressure Series AODD Metal Pumps. Specifically, these pumps can generate up to

300 psi of pressure (20.7 bar), which is a basic requirement for the reliable transfer of binders, solvents and additives that are viscous or contain solids.

Wilden offers four models of High-Pressure Series AODD Metal Pumps for use in paint and coatings applications:

- **H220:** This 1" (25mm) duplex pump uses both liquid chambers to pump fluid. It is constructed of ductile iron and creates a 3:1 pressure ratio with a maximum inlet air pressure of 100 psi (6.9 bar) and maximum discharge pressure of 300 psi (20.7 bar) while delivering flow rates up to 25 gpm (94 l/m). It can handle solids up to 1/4" (6.4mm) at operating temperatures to 266°F (130°C).
- **HS430S:** This 1-1/2" (38mm) simplex pump uses only one liquid chamber to pump fluid while the second is used as a pressure-amplification chamber. It is constructed of aluminum or stainless steel and creates a 2:1 pressure ratio with a maximum air inlet pressure of 125 psi (17.2 bar) and maximum discharge pressure of 250 psi (17.2 bar) while delivering flow rates up to 74 gpm (280 l/m). It can handle solids up to 1/4" (6.4mm) at operating temperatures to 266°F (130°C).
- **H800:** This 2" (51mm) duplex pump uses both liquid chambers to pump fluid. It is constructed of stainless steel or ductile iron and creates a 3:1 pressure ratio with a maximum air inlet pressure of 85 psi (5.9 bar) and maximum discharge pressure of 250 psi (17.2 bar) while



Wilden® H220 1" (25mm) Pump

delivering flow rates up to 95 gpm (359 l/m). It can handle solids up to 1/2" (12.7mm) at operating temperatures to 266°F (130°C).

- **H1500:** This 3" (76 mm) sanitary pump creates a 3:1 pressure ratio with a maximum air inlet pressure of 85 psi (5.9 bar) and a maximum discharge pressure of 250 psi (17.2 bar), delivering flow rates up to 77 gpm (291 l/m). It can handle solids up to 1/4" (6.4mm) at operating temperatures to 266°F (130°C). Meeting the highest industry standards—including 3A, ATEX, EC 1935/2004, USP Class VI and FDA CFR 21.177—this pump is ideal for low-acid, pasteurized, and protein-based products as well as biopharmaceutical sterile processes.

The H800 and H1500 models are available with Integral Piston Diaphragms (IPD). Featuring a one-piece design that eliminates outer-piston abrasion, these diaphragms deliver 2x to 15x longer life than traditional designs. They also eliminate a potential leak point, improving containment and safety while enabling faster product changeovers.

Conclusion

There's no question that the paint and coatings industry continues to evolve. A key part of this evolution is the wide array of next-generation feedstocks that are making modern-day paint and coatings a cutting-edge technology, from their increased performance to formulations that eliminate harmful volatile organic compounds (VOCs) and other environmental concerns. Paint and coatings manufacturers, therefore, must not only keep pace with the improvements in formulations, but in the pumping technology required to keep their operations running smoothly. Wilden lends a welcome hand with its High-Pressure Series AODD Metal Pumps, which possess the operational advantages that help ease the loading, unloading and transfer of today's more complex binders, solvents and additives.

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