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Progressive Cavity Pumps Enable Vital Precision and Repeatability

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Up until roughly five years ago, operators of manual and automated dispensing lines had little ability to achieve highly-accurate, consistent application of adhesives, epoxies and other fluids. This was especially difficult for small depositions, when working with viscous materials and when aiming for the fastest possible throughput speeds.

Jetting valves — perhaps the gold standard for high-speed, micro-deposit applications — can be unsatisfactorily turbulent in their accuracy. Time/pressure dispensers and auger valves can deliver accuracies down to ±10 and ±5 percent, respectively. But, they have a variance that might be unacceptable for many operators, with deposit size affected by temperature-driven changes in material viscosity, as well as fluctuations in air pressure created by the changing fluid level in the syringe barrel.

±10% & ±5%
Accuracy Level

±1%
Accuracy Level

The original volumetric or positive displacement pumps, such as piston or gear pumps, while able to get closer to the “holy grail” accuracy level of ±1 percent, are often limited in bead size and can be slow, due to their need to refill between depositions.

For many organizations, these limitations, along with the mandatory balancing act among variables, require prohibitive compromises. However, for an increasing number of companies in numerous, highly-competitive industries, the search for a superior adhesive and epoxy dispensing option has continued.

Progressive **Cavity Pumps**

Drawing on technology from heavy industry, such as oil drilling and cement processing, innovative dispensing equipment manufacturers have become aware of progressive cavity pump technology. Progressive cavity is a type of positive displacement pump technology long-proven in critical applications that include moving heavy oils and slurries from deep underground.

With the technology now successfully miniaturized and adapted to a tabletop or assembly line footprint, progressive cavity pumps offer a **number of advantages over conventional methods** of dispensing.

Unlike other types of epoxy and adhesive dispensing solutions, including other types of positive displacement/volumetric pumps and time/pressure valves, a progressive cavity pump is both a **sealed system and a continuous-flow operation**.

Progressive cavity pumps can dispense micro-beads as small as a microliter, using a wide range of materials with viscosities ranging from **1 to 300,000 cP or more**. And, since internal material flow is continuous, rather than relying upon a filling/refilling approach, throughput speeds are consistently high.

Most dramatically, however, progressive cavity pumps can deliver **volumetric dispensing accuracy up to ±1 percent**, and do so reliably. They are unhindered by the ambient temperatures and pressures that plague unsealed pumps exposed to environmental conditions, or variations due to changing material volume levels during operation.

How It Works

The essence of a progressive cavity pump is that it operates by use of a continuous rotor/stator configuration, rather than ejecting material from filling chambers at fixed, separated intervals. In progressive cavity technology, the feed fluid - from water up to high viscosity greases or solders - is held in a reservoir under positive pressure supplied by an air line. The pressure forces the fluid out of the barrel into the fluid feed path and then to the rotor/stator chamber assembly.

1

Single-Helix Rotor

The metal, single-helix rotor continuously turns inside a flexible rubber stator molded with a twin-helix-shaped aperture, forming a constantly shifting series of tightly sealed cavities, which move a precise, consistent volume of material steadily toward the pump outlet.

2

Proprietary Controller

From there, fluid is driven to the dispense tip outlet with a flow rate that depends on the rotor rotation in the feed direction. This process is precisely controlled by the desired specifications dialed into a proprietary controller paired with the system.

3

Enhancments

With this technology, the flow rate is adjustable at any time by changing the motor speed on the controller, as opposed to having to stop operation to adjust the pump itself, further enhancing speed and flexibility. The fluid is dispensed from the tip by a voltage signal applied to the motor, and shearing is achieved by reverse z-motion and tip retraction.

Numerous Benefits

Since the system is in constant motion and provides nonstop flow, it is **protected from many of the fluctuations** in fluid pressure that adversely affects deposition accuracy in many operations.

Progressive cavity technology all but **eliminates** the frequent occurrence **of small surges of pressure** that suddenly increase the output of the material dispensed, and then drop back, decreasing the size of the bead a few moments later.

With other pumps, this is not only seen as the level of material decreases in the tube, but also with any instability in the pressure source.

Instability may be caused by an air compressor that might drop in pressure if another load is placed on it simultaneously, or surge when it is removed.

Many operations using other types of pumps are also impacted by temperature changes, which impact viscosity. A small increase in temperature can decrease viscosity and increase flow speed, and detrimentally increase the size of the deposition. On the other hand, a small decrease in temperature can cause the fluid to thicken slightly and reduce the size of the deposition.

Progressive cavity technology protects against these unfortunate scenarios with its tight seal between the rotor and stator helping to ensure that the material in the cavities is well-protected from ambient temperatures.

This also helps keep the system resistant to material leaks, which can also degrade performance and create waste. Progressive cavity pumps can typically self-heal leaks at pressure up to **2 bar (30 psi)** or higher.

This technology is also more gentle and protective of the fluid itself.

Many types of pumps flatten soft solids and lead to reduced material performance or clogging of the needle.

The continuous moving rotor and soft stator causes less percussive impact on the material than, for example, a piston or centrifugal pump. Even very soft, solid powders, flux, and fillers can be mixed into the liquid without damage or losing performance.

With the wide range of viscosities it can handle, the pumps allow many users to adapt a single tool for numerous applications during assembly, such as dispensing both sealing compounds and oils.

Using one tool type for several applications can:

- cut down on parts inventory
- streamline training issues
- provide other cost
- productivity-enhancing benefits.

Configurations exist that can even dispense two-component epoxies with precise mixing ratios, while retaining the same dispensing accuracy.

Chemical Compatibility

Progressive cavity dispensing pumps are available from several companies, with some that manufacture their own brands and others that purchase and relabel the equipment.

Usually sold as a set, the controller brand is proprietary to the system and must be paired with the pump.

Material Composition

While design and performance can be similar, the material composition of the stator can differ widely among suppliers. Most operators should investigate this before purchase if they plan to dispense any type of caustic or aggressive solvent, such as acetone, MEK or xylene.

Rubber Blends

Rubber blends used for the stator are proprietary and can differ in the level of chemical resistance they provide and the range of dispensed materials they can be paired with. Some manufacturers provide stators that are made from standard rubber; these pumps can only be used with benign, non-corrosive materials.

Ensure Compatibility

Most all manufacturers will ask for the MSDS for the materials that operators will be dispensing to help ensure compatibility with the stator and other elements of their systems. Some will also accept samples of the material to test in a lab setting to ensure compatibility, as well as to provide users with estimated performance data, dispensing photos and settings information before purchase.

Factors to Consider

Available Accessories

Another possible factor to consider is the relative availability of accessories and equipment that might be teamed with the pumps in operation, such as robots and automation, pressure tanks and feeding systems, as well as dispense tips and syringes.

Costly Investment

It should be noted that perhaps the biggest downside of progressive cavity pumps is that they are a more costly investment than many other types of pumps. Prices for similarly performing progressive cavity pumps can vary considerably in the marketplace.

Complete Line

Some manufacturers might offer a more complete line, some might repurchase or rebrand needed supplies. For some operators, purchasing from different sources to try to secure the lowest individual off-brand prices might seem like the correct strategy. Others might prefer the benefits of single brand compatibility and a single source of product and system performance responsibility.

Worth the Investment

Certainly, every dispensing operation "wants" greater accuracy, and the progressive cavity pump is one of the only options to get the process to a ±1 percent accuracy level.

±1% Accuracy Level

The truth is, for some applications, repeatable accuracy, while "nice to have," might not translate directly into profitability and competitive advantage.

Others might potentially benefit, but, due to internal politics, lack of funds, lack of knowledge or other factors, might not be able to break away from the way things have been done in the past.

Many of the earliest adopters benefiting from the technology, demonstrating higher profits and greater competitive advantage, include those operations involved with:

- **Under-filling PCB Assembly Components**
- **Automotive Parts Lubrication**
- **Optical Bonding**
- **Conformal Coating and Similar High Value Electronics**
- **Potting and Encapsulation Applications**
- **Medical, Automotive, Aerospace, and Other Industrial Applications**

For these types of applications, the additional upfront investment is quickly returned.

The bottom line, of course, is that it is up to each operation to crunch the numbers for themselves, as only they can accurately predict what, if anything:

- increased dispensing accuracy and consistency
- superior product quality greater throughout
- reduced waste of material and product

This could mean profitability of their operation.

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