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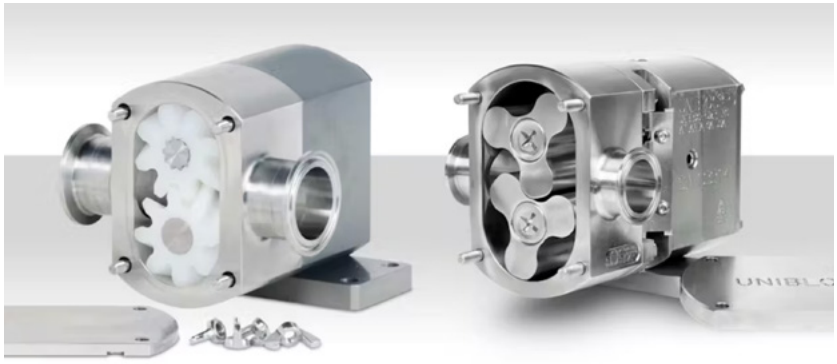
Understanding the working principles of positive displacement pumps

By selecting the right positive displacement pump for an application, processors can achieve significant improvements in operational efficiency, product quality and maintenance costs.

| By Calle Danielsson



In process manufacturing, reliable equipment makes all the difference between smooth operations and costly downtime. Among the unsung heroes of processing plants are positive displacement pumps — workhorses that keep products moving efficiently through production lines.

Whether you are transferring chocolate, paint, creams or other products, choosing the right pump technology impacts everything from product quality to your maintenance budget. In this article, you will learn how positive displacement pumps can support your processing operations and why choosing the right pump design matters.

- Discover the key differences between lobe pumps, gear pumps, and centrifugal pumps.
- Uncover the underappreciated maintenance costs impacting your bottom line.
- Learn how modern pump designs are reforming cleaning processes.
- Explore selection criteria beyond basic specifications.
- Find out how the right pump can improve product quality and operational efficiency.

What is a positive displacement pump?

At its core, a positive displacement pump works by trapping a fixed amount of fluid and forcing it from the intake side to the discharge side of the pump. Unlike dynamic pumps that depend on velocity to move fluids, positive displacement pumps physically push the product through the pump, creating flow that is directly proportional to the pump's rotor speed.

This working principle makes positive displacement pumps particularly effective when consistent, precise flow is required, regardless of fluctuations in discharge pressure. As the pump's internal components (lobes, gears or vanes) rotate, they create expanding cavities on the suction side, drawing fluid into the pump. These cavities then seal and transport the fluid to the discharge side, where the cavity collapses, forcing the fluid out of the pump.

(Note: For the purpose of this article, positive displacement pumps are defined as lobe pumps, gear pumps and vane pumps. Some industry professionals include other types of pumps in their definitions.)

Unlike reciprocal pumps, the rotary motion of lobe and gear pumps offers a pulse-free precise flow. Gear pumps, in particular, when operated at low speed, offer volumetric control suitable for filling and metering operations.

The mechanical simplicity of their design, combined with the ability to handle fluids of varying viscosities, makes positive displacement pumps indispensable to diverse processing applications from food production to pharmaceuticals.

What is the difference between a centrifugal pump and a positive displacement pump?

The fundamental distinction between these pump types lies in how they move fluids. Centrifugal pumps rely on rotational energy from an impeller to create velocity, which then converts to pressure energy as the fluid exits the pump. By contrast, positive

displacement pumps capture and move discrete volumes of fluid through the system.

This difference creates several important operational contrasts:

- **Flow rate response:** Centrifugal pumps provide variable flow based on system pressure — as back pressure increases, flow decreases. Positive displacement pumps maintain nearly constant flow regardless of pressure changes.
- **Speed and pressure:** Centrifugal pumps typically operate at higher speeds (often 1,750-3,500 RPM) and lower pressures, while positive displacement pumps can generate much higher pressures while operating at lower speeds (100-600 RPM), reducing wear.
- **Product handling:** Centrifugal pumps may create product-damaging shear because of high speeds and impact forces.
- **Efficiency with viscous materials:** Centrifugal pump efficiency drops dramatically when handling viscous fluids, whereas positive displacement pumps maintain efficiency across a wide viscosity range.

Preserve product integrity through low-shear operation

A key advantage of positive displacement pumps is their ability to handle shear-sensitive products without compromising quality. In many processing applications — particularly with food and personal care products — maintaining product texture and appearance is non-negotiable.

When products such as ground meat or cosmetic creams are subjected to the high speeds and centrifugal forces of conventional pumps, they can experience "smear" or texture degradation that consumers find unappealing. Lobe, gear and vane pumps operate at lower speeds with gentle product handling, preserving the intended consistency and appearance of products.

One of the most surprising benefits of these pumps is their versatility. A well-designed lobe pump can handle viscosities ranging from 1 to 1,000,000 centipoise — meaning the same pump could transfer thin liquids or substances as thick as peanut butter. This versatility enables processors to accommodate multiple product types without investing in separate pumping stations.

Lobe vs. gear pumps: choosing your champion

For process manufacturing professionals, understanding the differences between lobe and gear pumps is essential for optimal operations:

- **Lobe pumps:** With relatively large cavities, these pumps gently move solids and highly viscous materials. They are ideal for high-pressure, high-temperature applications and for handling abrasive or shear-sensitive products. Many models avoid metal-on-metal contact, making the pump hyper-hygienic.
- **Gear pumps:** These pumps shine when handling products like fats, oils and glycerin, whose high lubricity lowers friction. Their helical gear design provides smooth, quiet operation with minimal pulsation — critical for accurate dosing and consistent flow rates.

The underappreciated cost of pump maintenance

What many processing engineers do not realize is the extent to which maintenance issues drain operational efficiency. When pumps require daily cleaning — as they often do in viscous applications — the process traditionally consumes significant time and labor.

Standard hygienic pumps often have numerous parts and require tools for disassembly. This complexity not only extends downtime but also increases the risk of improper reassembly, particularly during third-shift operations when staffing skilled technicians is a challenge.

The experts at Unibloc Hygienic Technologies (UHT) have observed that up to 90% of pump damage incidents occur during cleaning processes — not during normal operation. This damage leads to unplanned downtime and costly repairs.

The maintenance equation

Modern pump designs are changing the maintenance equation. Some pump manufacturers have implemented design innovations that allow technicians to take apart, clean and reassemble a lobe pump in 20 minutes or fewer —compared to two hours for traditional pump designs.

For example, QuickStrip lobe and gear pumps offered by UHT have features that contribute to faster maintenance cycles:

- Tool-free disassembly enables crews to access pumps quickly.
- Bolt-free rotors don't need torquing.
- Swing-arm covers eliminate the need to place heavy pump covers on the floor during cleaning.
- Parts designed for one-way assembly prevent improper reassembly.
- A minimal number of small parts reduces the chance that a part will be lost during cleaning.
- Safety Swing Arm reduces the risk of worker injury caused by dropping the heavy pump cover.

By selecting the right positive displacement pump for an application, process manufacturers can achieve significant improvements in operational efficiency, product quality and maintenance costs — making their processing facility more competitive.

About Unibloc Hygienic Technologies

Unibloc Hygienic Technologies (UHT) delivers precision-engineered positive displacement and air-operated double-diaphragm pumps designed for the most demanding hygienic applications. Built for proven pump performance, UHT pumps are engineered to outperform, built to outlast, and designed to save more—giving processors and OEMs the durability, ease of maintenance, and Total Cost of Ownership savings they need to compete.

Learn more at **www.unibloctech.com**.