

Chemical Delivery and Metering System with No Moving Parts for High Purity and Other Industrial Applications

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Abstract. We will discuss a chemical delivery and metering system that has no moving parts in its pumping system. It has no impellers, diaphragms, pistons, or membranes to break, leak, deteriorate or otherwise contaminate or get in the way of full uptime and ultra-high purity fluid delivery. The lack of moving parts minimizes wear, contamination, and maintenance costs, while maximizing uptime and reliability. It can deliver chemicals at high flow rates while keeping a metering accuracy 100-200 times better than conventional systems. The system is also capable of self-priming from a height of over 25 feet and of continuous operation at temperatures of 200 C°.

Moving parts will experience wear under normal operation. This produces particles and eventually causes parts to underperform or fail. In 24 years of designing and manufacturing wet etching and chemical handling equipment we have experienced firsthand most failure modes and maintenance issues in all conventional types of pumping systems. In almost every instance, the failure involved seals, bellows, impellers, motors, diaphragms, or other moving parts of the pumping system.

The *Aeris*™ Precision Chemical Delivery and Metering system has no moving parts¹. It moves fluids using MATECH's patented positive displacement piston-less technology. This technology does not use pistons, seals, impellers, diaphragms, or any other moving part in contact with the liquid being pumped. As a direct consequence, the uptime and reliability increase, and the cost of ownership is reduced. Also, since there are no moving parts to wear, it makes the entire fluid path virtually particle-free, making it an ideal system for ultra-high purity applications, such as those in semiconductor fabrication and pharmaceutical industries.

Another desirable feature of the *Aeris*™ system is its exceptional self-priming performance. The Aeris Precision system can prime from a height of over 25 ft without any assistance and it senses automatically when the fluid is ready to be pumped. The Aeris Precision system will prime unaided from several feet over the fluid source even with the most viscous or dense liquids.

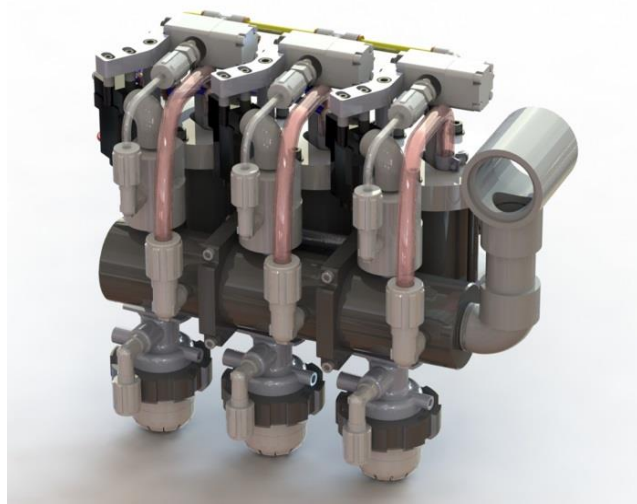


Figure 1. Multichannel Aeris Pump Engine

¹ Other than PFA valves

In conventional systems, depending on the type of pump used to withdraw chemicals from their reservoirs, priming can be an issue requiring sensors, or priming-aids to insure consistent delivery from the chemical reservoir to its destination. Conventional systems can have special difficulty with dense or viscous fluids. Priming failures in automated delivery or metering systems are a recurring source of problems resulting in downtime, spoiled product, lower yields, lower net throughput, and higher costs.

In general, pumps relevant to this subject can be classified as either of two types: Centrifugal or positive displacement. They move fluid by virtue of different physical phenomena. Centrifugal pumps impart velocity to the fluid being pumped and as the fluid exits the pump the kinetic energy is converted into potential energy (i.e. pressure). There are various types of centrifugal pumps, but they share most important traits.

Positive displacement pumps work by filling a volume and displacing it at a certain pressure. A hallmark characteristic of positive displacement pumps is that they deliver a constant volume per cycle, regardless of the discharge pressure. Also, and very important in some cases, is that centrifugal pumps' flow is reduced as the viscosity is increased, while positive displacement pumps' flow tend to remain constant or slightly increase as the viscosity of the fluid increases. In fact, centrifugal pumps become very inefficient at high viscosities.

Similar considerations apply to the pumps' mechanical efficiency with respect to pressure: changes in pressure have little effect in a positive displacement pump flow, while they can have dramatic effects in a centrifugal pump performance. Also important is that centrifugal pumps, since they are designed to work with incompressible fluids, need to be filled with fluid, or primed, before they can perform nominally. In contrast, positive displacement pumps can usually generate enough vacuum to self-prime without difficulty.

Given the above it can be seen why the *Aeris*™ positive displacement pump engine will pump virtually any fluid, regardless of its density or viscosity. The engine's sensors and software "know" the level of fluid in the chambers and adjust its duty cycle accordingly, automatically compensating for even extreme changes in viscosity or density without user intervention.

And since all wetted parts are either PTFE or PFA, including the chambers and, optionally, the tanks, the whole pumping and metering system can operate at high temperatures (up to 200 °C) and with virtually any chemical.

Along with raw performance, a good delivery system has to be robust, easy to maintain, with very high uptime, and be cost effective. The bottom line is that to achieve robust and consistent precision



Figure 2. Aeris smallest member of the family. Pictured: Control Module and 3-channel Benchtop system.



Figure 3. Aeris™ Precision system configured with two 55 gal drum delivery cabinets. On the left is the control console, on the right, the two drum cabinets. Carboy and bottle cabinets are also available and can be configured in any combination.

metering requires a system approach. It is not entirely about any one of the components, but about how the system's components and their software perform together to give the best results. In the case of the Aeris™ Precision chemical delivery system, these results translate into high flow rates (to deliver high volumes fast) while achieving very accurate precise fluid metering; all at the same time, with no compromises.

Finally, an often overlooked aspect of chemical handling and delivery is the role it plays in lab or fab safety and in reducing employer liability. By minimizing personnel handling of chemicals, pouring from bottles, or any other form of exposure to chemistries, worker safety is improved and employer liability is reduced. This aspect alone warrants a good look at how chemicals are handled in every facility.

Aeris™ Chemical Handling and Metering systems are available configured for the end user application or in OEM versions to be integrated into other systems. They come in a wide range of sizes, from ml/min to gal/min systems; from in-the-hood lab systems to 55 gal bulk delivery systems. Depending on the size and intended use they accommodate from pint-size chemical bottles to 55 gal drums in their input bays.

For further information on MATECH's Aeris™ Precision Chemical Delivery and Metering system please contact MATECH directly at +1 (845) 463-2799, or via email at info@matech.com, or go to MATECH's website at www.matech.com.