A typical water treatment, chemical process or agriculture application can consume large amounts of chemicals during daily operations. While the volumes may be large, they must be very precise, with exact amounts delivered according to strict injection schedules. The pressures that the chemicals are injected at must also be governed precisely, and these can range across a very broad spectrum. This demand for precise flow rates at predetermined schedules and pressures requires the use of a very specific pumping technology that can ensure successful, reliable adherence to the injection schedule and fluid volumes.

Today, as modern metering pump technology can be easily set to deliver exact volumes according to a set schedule, and at various pressures, metering pumps have become the trend for the purposes of chemical injections in water treatment, processing and agricultural applications. However, there are many different styles and modes of operation within the realm of metering pumps. This article will explain the different metering pump technologies and demonstrate how the user should select the proper size and style depending on the injection application for which the pump will be tasked.

Know the Variables
When determining the most suitable metering pump for a chemical-injection application, there are multiple variables that must be factored into consideration, including:

- **Flow Rate**
  Metering pumps should never be oversized, meaning that determining the exact flow rate that is required for the application in question is of paramount importance. With this in mind, a metering pump should be sized so that the maximum expected flow rate is 85% to 90% of the pump’s capacity, which will leave room for additional capacity, if needed.

- **Materials of Construction**
  Metering pumps are available in a variety of materials, most commonly 316 stainless steel, C-20 stainless steel, PVC and Kynar® PVDF. When selecting a metering pump’s materials of construction, the corrosion, erosion and solvent action of the chemical must be taken into consideration. For example, solvent-based chemicals may dissolve plastic-headed pumps, while acids and caustics may require stainless-steel models. The effects of erosion must also be considered when the chemical takes the form of abrasive slurry.

- **Chemical Composition**
  Chemicals come in many formulations, from extremely thin to highly viscous, while they can also be classified as a slurry or off-gas when transferred. Standard metering pumps are typically able to handle clear liquids with viscosities ranging from water-like to 1,500 cPs. Chemicals with viscosities that approach 5,000 cPs or have light suspensions will require special liquid ends. Those with viscosities up to 20,000 cPs or that contain up to 10% solids will require special diaphragms, while ones that automatically vent accumulated gas will need their own variety of liquid ends.

- **Driver**
  Drivers, which can be powered by electricity, water, gas, air or the sun, must be selected according to the utilities that are available. Driver selection must also take into account any environmental hazards that may be found in the operating area, with the operator realising that pumps used in remote locations may not be able to be inspected as often as those in controlled environments.

- **Environment**
  Determine if the pump will be operating indoors or outdoors. If used outdoors, the pump must be sheltered from direct sunlight. Any pumps that will be used in freezing temperatures can only pump fluids that will not freeze at that temperature.

- **Method of Control**
  The operator must know how the pump will be used, either manual continuous operation, on/off operation or remote operation that is governed by a process signal. When all is said and done, method of control may be the most important variable when choosing a metering pump, so let’s take a closer look.

Many styles of metering pumps allow flow rates to be adjusted manually through the use of a micrometre dial. Adjusting this dial changes the pump’s stroke length and allows the pump to be operated anywhere between 10% and 100% of its rated flow capacity. Metering pumps with micrometre dials may also feature a variable speed drive that allows adjustment of the pump’s stroke speed. Utilising the two in unison can allow additional adjustability or turndown capabilities over the range of the drive, depending on the pump’s stroking speed. For example, a pump operating at 75 strokes per minute (spm) would produce a 5:1 turndown ratio on speed with the variable speed drive and a 10:1 turndown ratio on stroke length via the micrometre dial.

How to Size and Select Metering Pumps

Metering pumps have long set the standard in chemical-injection applications, but only if the operator selects a model that addresses all of the operational variables.
Flow rates can also be controlled automatically by a process signal and through the implementation of electric or pneumatic positioners that can adjust the stroke length, which will deliver a full 10:1 turndown ratio. In this method of control, the number of doses will remain constant with the size of each dose reduced, resulting in doses that are uniformly distributed in a constantly flowing line. Metering pumps that use a variable speed drive will deliver a turndown ratio that is determined by dividing the pump's stroke speed by its minimum operating speed. A variable speed drive will enable the pump to inject a dose of the same size on each stroke, but since the stroke speeds will change, the doses themselves will be less frequent. Additionally, it is not practical to use a variable speed drive on motor-driven pumps that normally operate at speeds less than 100 to 150 rpm, since slowing the motor requires each stroke to take longer to complete from start to finish. However, electronic metering pumps, which are pulsed by a solenoid, can operate at less than 1 rpm because the volume of each stroke from start to finish is uniform at every stroking speed.

Planning a Metering Pump Installation

Planning a metering pump installation involves a long list of important variables that must be considered, along with an array of pump components that will help optimise performance, if deployed appropriately. Successful chemical injection via metering pump will only be achieved if all variables are taken into consideration and system installation adheres to suggested protocols. WWA

• Suction Strainer
Suction strainers should always be used as it will prevent foreign matter from entering the pump’s ball checks.

• Flanges/Unions/Compression Fittings
At least one of these must be installed at the pump’s suction and discharge ports in order to facilitate maintenance procedures more easily.

• Isolation Valves
Large-port, quick-opening isolation valves should be placed at both the suction and discharge ends of the installation as a way to ease maintenance operations. Ball valves are usually the best choice for this operation, while needle valves should not be used because their design will cause the creation of a flow restriction.

• Calibration Column
As metering pumps very often feature pulsed flow at low volumes, a draw-down calibration column is the most accurate and convenient method to measure pump performance, provided that the liquid in the column draws down smoothly and stops precisely at the end of each suction stroke. A tall, thin column should be used to ensure ease of reading and reporting accuracy. Calibration columns can also be helpful in determining if any wear has occurred or dirt has accumulated in the pump’s check valves, if the liquid in the column “bounces,” that may indicate that the valves are worn or dirty.

• Relief Valve
Though the metering pump may be constructed with an internal relief valve, it is recommended that an external relief valve be installed. The external relief valve should be set at 50 psi (3.5 bar) or 10% above the maximum operating pressure where fluid acceleration during the pumping process can adversely affect the pump’s maximum pressure capacity or relief valve setting. The pulsation damper will minimise the pressure spikes that may be caused under these acceleration circumstances and, in the case of high-volume pumps, reduce piping harmonics.

• Injection Quills/Check Valves
An injection quill that is installed at the pump’s injection point will serve as a check valve while providing better dispersion of the chemical. In low-pressure applications, an injection quill that incorporates a corporation stop, which allows the injection quill to be inserted or removed without having to drain or shut down the system, will improve efficiency and overall performance.

Conclusion

In process or agricultural applications where precise, reliable, efficient injection of chemicals is critical to optimising performance, metering pumps have been proven over the years to deliver the required method of operation. However, knowing that requiring a metering pump is not nearly enough to ensure that the best pump will be chosen for the job. A long list of important variables must be considered, along with an array of pump components that will help optimise performance, if deployed appropriately. Successful chemical injection via metering pump will only be achieved if all variables are taken into consideration and system installation adheres to suggested protocols.