

Metering Expectations

CHOOSING THE CORRECT METERING PUMP WILL ENSURE THAT LIQUIDS ARE INJECTED IN THE MOST PRECISE, EFFICIENT, ENVIRONMENTALLY FRIENDLY AND ENERGY-CONSCIOUS MANNER

By Tom O'Donnell



The Challenge

At their simplest, metering pumps are used to inject liquids at precisely controlled, adjustable flow rates, which is a process that is often called “metering.” As defined by the Hydraulic Institute’s Metering Pump Section, controlled-volume metering pumps are reciprocating positive-displacement pumps that are typically used for the injection of chemical additives, proportional blending of multiple components or metered transfer of a single liquid.

Metering pumps are used to pump chemical solutions and expensive additives that are used in products manufactured in a wide variety of industries, including industrial, medical, chemical, food and dairy, pharmaceutical and biotech, environmental, fuel cell and laboratory. Metering pumps are designed to pump into low or high discharge pressures at controlled flow rates that are constant when averaged over time. Metering pumps consist of a solenoid drive or a gearbox with motor, a control mechanism, plus a

pump head with valves to control direction of flow—through which the liquid being pumped enters the inlet connection and exits the discharge connection.

Since liquids are only slightly compressible, they are able to be discharged at high pressure by metering pumps. Gases, on the other hand, are much more compressible, making them incompatible with metering-pump use. Therefore, problems can occur in a metering-pump application when gas bubbles enter the pump head. When this happens, the pump can suffer from “vapor lock,” a condition in which the pump will stop pumping the liquid that contains gas bubbles while repeatedly compressing and decompressing the bubbles.

Another challenge in the use of metering pumps can occur when the pump’s outlet pressure is lower than the inlet pressure. When this situation arises, both check valves will open simultaneously and the liquid will flow through the pump head uncontrollably from inlet to outlet. A properly

rated pressure-differential check valve placed downstream of the pump will arrest this undesirable flow condition.

Despite these concerns, metering pumps remain one of the most versatile and relied-upon technologies for the safe, accurate and efficient injection of a unique array of chemicals up to 20,000 cps and slurries containing up to 10% solids. The goal of this white paper is to help the user define the variables that need to be evaluated when choosing and installing the proper metering pump or complete chemical-feed system. Choosing the proper system will not only help inject liquids or slurries regardless of viscosity, but also ensure that it is done in the most efficient, environmentally friendly and energy-wise manner.

The Solution

As seems to be the case with most everything, size really does matter when determining the proper metering pump to be used in an application. More specifically, the size in terms of capacity of both the pump's flow rate and discharge pressure. Simply put, metering pumps should not be oversized. In fact, a metering pump should be sized so that its maximum expected flow rate is 85% to 90% of the pump's capacity, which leaves additional capacity, if needed. At the other end of the spectrum, a metering pump's minimum capacity should never be less than 10% of the capacity; anything less will affect the pump's accuracy.

Determining the proper flow rate and discharge pressure can't be done until the types of substances that are going to be pumped are identified per specific application. Basically, you need to know the viscosity of the liquid, or if it is a slurry. Standard metering pumps handle clear liquids with viscosities generally ranging from water—which has a viscosity around 1 cps—to 1,500 cps. Special liquid ends for applications outside this viscosity range are available for viscosities up to 5,000 cps. When considering true slurries or liquids with even higher viscosities, special tubular diaphragm heads are compatible viscosities to 20,000 cps and slurries that contain 10% solids.

Another key determination is materials of construction. Selection of a metering pump must take into consideration any corrosion, erosion or solvent action that may occur when handling specific substances. For example, solvents may dissolve plastic-headed pumps, acids and caustics are only compatible with stainless steel or certain steel alloys, and abrasive slurries can erode some materials.

Therefore, the best lines of metering pumps will be available in a range of materials of construction, allowing the end-user to choose the best option for his specific applications.

When considering the type of head the pump should feature, remember that double-diaphragm heads with leak detection and alarm capabilities are available for applications where any diaphragm failure must be sensed immediately.

Selecting a driver is also an area of concern. A driver should be chosen by matching it to the available utilities, which usually include electric, air, gas or other means of driving the pump. When the pump's parameters are determined, you must then consider the environment in which the pump will operate. Hazardous-area requirements must also be identified when selecting the driver.

When evaluating a hazardous environment, remember to consider dust, which can ignite, just like fumes or vapors. Is the pump to be utilized indoors or outdoors? If it's located outdoors, it should be sheltered from direct sunlight. As far as temperature requirements, most pumps will operate in freezing conditions provided that the fluid to be pumped will not freeze and that the correct lubricants are selected. In this case, freeze protection and heat-tracing may be required, while operation in corrosive environments may require special pump coatings.

Determining the pump's method of control is next on the list of determining factors. The choices usually include manual continuous operation, on/off operation or automatic proportional control in response to a process signal.

In general, metering-pump flow rates can be manually adjusted through the use of a micrometer dial. This manual control allows the pump to be operated between 10% and 100% of capacity by changing the stroke length. By comparison, a manual variable-speed drive changes the stroke speed. A combination of the two may allow additional adjustability or turndown over the range of the drive, depending upon the stroking speed of the pump. For example, a pump operating at 75 strokes per minute (which could be turned down to 15 spm) would allow a 5:1 turndown on speed when using the variable-speed drive and a 10:1 turndown on stroke length when using the micrometer dial.

Metering-pump flow rates can also be controlled automatically (in response to a process signal) by electric positioners that change the pump's stroke length, or by



Hydraulic Diaphragm Pump

variable-speed drives that alter the stroking speed. Using a positioner gives the operator a full 10:1 turndown, which is the full adjustable range. Using a variable-speed drive will supply only as much turndown as the ratio of the pump stroking speed divided by the minimum operating speed of the pump.

Be reminded that it is not practical to use a variable-speed drive on motor-driven pumps that normally operate at less than 100 spm to 150 spm. Slowing the motor causes each stroke to take longer from start to finish and, as a practical matter, motor-driven pumps should not be operated at less than 15 spm. Electronic diaphragm pumps, which are pulsed by a solenoid, can operate at less than a single stroke per minute because the characteristic and timing of each stroke, from start to finish, is the same at all stroking speeds. The

moving parts in modern diaphragm pumps offer long, reliable service at all stroking speeds. The highest stroking speeds should be avoided with viscous or abrasive chemicals.

When a metering pump is controlled by automatic or electric stroke positioners, the number of doses remains constant and the size of each dose is reduced, thus keeping the doses uniformly distributed in a constantly flowing line. Use of a variable-speed drive changes the stroke speed, while the size of the dose injected on each stroke remains the same, but makes the doses less frequent. This, however,



Electronic Diaphragm Pump

Planning a Metering Pump Installation

A metering-pump installation must be planned from the day tank or liquid source up to the injection point. Remember that metering pumps will “push” against great pressures but they will not “pull” for great distances. Since it is easier to prime and more forgiving, a flooded suction is always preferred, and must be used for fluids where vapor pressure might be less than the suction lift.

Be careful to limit the suction to four feet in a suction-lift application, and a foot valve must be used in a top-mount application. Limit the length of a flooded suction to six or seven feet and use an adequately sized line with minimized bends, elbows or other restrictions. When considering the piping, the safest rule-of-thumb for selecting suction pipe size is to use one size larger than the pump suction connection. For discharge piping, specify piping that is suitable for the discharge pressure.

Other accessories to be considered when planning a metering-pump installation include:

- Suction strainer
- Flanges, unions or compression fittings
- Isolation valves
- Calibration column
- Relief valve
- Back pressure valve
- Pressure gauge
- Pulsation dampener
- Injection quill and check valve

Finally, remember that when replacing equipment or changing chemical programs, it is best to ask questions. Will the new program operate at the same feed rates as the previous one? Is the equipment properly sized for the new products? How well has the equipment been operating? Any problems with reliability, accuracy or unusually high maintenance requirements? There is no better start to a new chemical-feed program than to ensure that the chemical is delivered accurately with trouble-free equipment.



RELIEF VALVE



BACK PRESSURE VALVE



CORPORATION STOP WITH INJECTION QUILL



INJECTION QUILL WITH CHECK VALVE



PULSATION DAMPENER



CALIBRATION COLUMN

can produce an undesirable process result in a constantly flowing line as the discreet slugs of chemical are more widely separated than if a constant dose interval were maintained.

Finally, consider the application and level of quality. Is the unit to be used for intermittent operation in an HVAC or light-duty applications where economy is an important consideration? Is the unit for an industrial plant/waste-treatment facility/refinery/power plant where ruggedness and additional features are required? Is initial cost or life-cycle cost more important?

Leaders in Metering Pump Technology

By taking all of these design and selection requirements into consideration, the Neptune Chemical Pump Co., Lansdale, PA—which in April 2008 became a member of the Redlands, CA-based Pump Solutions Group (PSG™), a consortium of six of the world's leading pump manufacturers—has grown to become one of the world's leading producers of chemical metering pumps.

Neptune's hydraulic and mechanical diaphragm metering pumps become the industry standard for applications that require the injection of chemicals into boilers and cooling towers, and in water and wastewater-treatment applications. Other major applications for these pumps include the power generation, oil-and-gas exploration, petrochemical and irrigation markets.

Setting the standard in hydraulic diaphragm metering pumps are Neptune's Series 500 and 600 offerings. These pumps feature innovative designs for precision for long-term reliability. They incorporate a variable oil by-pass stroke adjustment with stroke capacity capable of being adjusted by micrometer dial while the pump is either running or stopped. Spm is controlled automatically through speed adjustments. Maintenance is simplified through the use of valve cartridges that can be removed for cleaning or replaced without disturbing the piping. Available in stainless-steel, PVC, Alloy 20 and Kynar construction, these pumps are compatible with the most-corrosive elements.

Neptune's Series 7000 mechanically actuated diaphragm metering pumps eliminate the use of contour plates on the liquid side of the diaphragm, which creates



Mechanical Diaphragm Pump

improved flow characteristics. Series 7000 pumps are also self-priming and have the ability to handle chemicals that produce off-gas. These pumps can also handle viscosities in excess of 5,000 cps, while maximum capacity ranges from 15 to 300 gph to 150 psi. The pump capacity can also be adjusted by micrometer dial while the pump is running, and the variable-speed drives allow greater turndown range or automatic capacity control. All moving parts of the Series 7000 run submerged in oil for extended service.

PZ Series electronic diaphragm metering pumps offer the industry's leading "pulse" metering-pump design as the pumps operate on any single-phase voltage from 94 VAC to 264 VAC. The manual stroke-length adjustment ranges from 50% to 100%, while proportional control, cycle and counter functions are built in to the unit. PVC, acrylic and Kynar models are available with an automatic de-gassing valve for chemicals and liquids that "off" gas.

Conclusion

If you're looking for the metering-pumping technology that offers the best in operation, reliability and energy efficiency when handling a wide array of liquids, chemicals and slurries, look no further than metering-pump technology from Neptune. Neptune is not content to rest on its metering-pump laurels as the company continuously looks to improve its products while looking for new ways to aid the many industries it services.

Metering pumps play a key role in the smooth operation of many diverse industries. In a world where optimizing production schedules, efficiencies and energy costs is becoming more and more important, Neptune chemical-metering pumps continue to set the standard the world over.

Tom O'Donnell is Senior Product Specialist for Lansdale, PA-based Neptune Chemical Pump Co., an operating company with the Pump Solutions Group (PSG™). Mr. O'Donnell can be reached at todonnell@neptune1.com or 215-699-8700. PSG is comprised of six leading pump companies—Wilden®, Blackmer®, Griswold™, Neptune™, Almatec® and Mouvex®. You can find more information on Neptune Chemical Pump at www.neptune1.com and PSG at www.pumpsg.com.

You can find more information on Neptune Chemical Pump at www.neptune1.com and PSG at www.pumpsg.com.

