

# Acing The Acid Test

DIAPHRAGM METERING PUMPS FROM NEPTUNE™ CHEMICAL PUMP COMPANY  
 PROVE THE PERFECT ACID-HANDLING SOLUTION IN WATER/WASTEWATER APPLICATIONS

*By Ken Underwood*



Acids do not discriminate when attacking equipment that has not been properly designed for its handling. As viewed above, for example, a skid treated with inadequate coating or a pump misapplied for acid-feed use (inset) all display the effects of acid corrosion.

No life form, whether it be human, animal or plant, can survive without water. The same can be said for many industries, whether they be mining, food and beverage processing or steel manufacturing. In most instances, water is used to help facilitate and optimize the production process, from cooling equipment to cleaning totes, barrels and storage tanks.

When used in these types of applications, clean water is quickly transformed into wastewater that is full of impurities. With increasing regulatory vigilance regarding how this wastewater is handled, it needs to be disposed of or recycled in the most environmentally friendly manner possible. Aiding in the cause of wastewater disposal or recycling is a wide range of acids that are used to help process wastewater and make it safe to either be reused or returned to the environment.

This white paper will highlight the pumping technology – specifically, diaphragm-type metering pumps – that most successfully meets the challenges inherent in most wastewater-handling applications that require the use of a wide array of acids.

## The Challenge

Acids are an industrial jack-of-all-trades and used in a dizzying variety of unique applications and processes, including the manufacture of agricultural fertilizers, cosmetics productions, fluoridation of drinking water, pH adjustment in cooling towers and boiler water pretreatment. This versatility also makes acids a critical component in water-and wastewater-handling operations.



Neptune 500 Series Acid Skid Feed Systems. Inset photo shows system with containment.

A few of the more commonly used acids in these applications, and their characteristics, include:

- **Hydrofluosilicic Acid:** Occasionally referred to as “silly” acid, hydrofluosilicic acid is often used in the fluoridation of drinking water, as a wood preservative agent and in the production of ceramics. Hydrofluosilicic acid is corrosive to most metals, and has a tendency to find leak paths.
- **Hydrochloric Acid:** Also known as muriatic acid. This acid is used to remove scale from boilers, in chemical cleaning and to regenerate water used in treating deionization units.
- **Phosphoric Acid:** Used in metals processing, as an etching agent in semiconductor processing and as a nutrient for biological growth.
- **Sulfuric Acid:** Commonly used for pH adjustment in water treatment, manufacture of car batteries, as well as the pickling, cleansing and plating of metals. Because sulfuric acid is highly exothermic, it is one of the more challenging acids to pump.
- **Citric Acid:** A rather weak acid, it is used as a preservative and flavoring agent in food and beverage processing, and as an ingredient in the manufacture of cosmetics, pharmaceuticals and household cleaning products.

What all of these acids have in common is that safety in containing, controlling and handling them is a critical concern, not only to protect the health and productivity of workers, but to ensure zero impact on the environment. With that said, some acids are more aggressive than others and their corrosive nature and temperature can change dramatically at different concentrations or when diluted.

Because of the aggressive nature of acids and the need to accurately control the dosage rate to avoid overfeeding, they need to be fed via a metering pump that has a high level of repetitive accuracy, generally +/-1%. The material that the pump is constructed of also requires thoughtful consideration. While C-20, PVDF and PVC are the most commonly used liquid end materials in acid-metering pumps, care must also be taken that all wetted components are compatible with the specific acid being handled because no one single material works well with all acids. Choosing the wrong materials of construction can lead to, at least, pump failures and, at worst, acid leaks that can harm personnel or the environment.

## The Solution

As mentioned, the best choice for acid injection in wastewater-handling applications is hydraulic, mechanical or electronic diaphragm metering pump technology. When considering these types of pumps, one company has taken the lead: Neptune™ Chemical Pump Company, North Wales, PA, USA. Neptune’s hydraulic diaphragm metering pumps – specifically the 500 Series – and mechanical diaphragm metering pumps – the 7000 Series – along with the PZ Series electronic solenoid-driven metering pumps help set the standard in safe, efficient, reliable acid-handling in wastewater applications.

Neptune’s 500 Series hydraulic metering pumps are ideal for acid-handling because they can inject a precise and controlled amount of chemical; feature an internal relief valve; have leak-free operation; can handle higher pumping pressures; require minimal maintenance; can be constructed with an automatic stroke control actuator or variable-speed motor; have low energy usage; and feature an easily adjustable micrometer dial that can be adjusted whether the pump is running or stopped.

Neptune has also designed its 500 Series pumps to operate in the harshest product-handling conditions and last for up to 20 years of service. Hydraulic diaphragm pumps also have a flow-rate deviation of less than 1%. The 500 Series pumps feature a 10-turn micrometer dial that can be calibrated to 1% increments from 10% to 100% of flow

capacity, with the color-contrasted dial protected by a clear PVC covering. Additionally, the pump's stroke mechanism moves only when adjusted, which eliminates unnecessary wear, while the piston is powered through the complete stroke length at all capacities to remove any concerns about excessive stress, wear or shock.

The 500 Series pumps also feature a Variable Oil By-Pass™ stroke adjustment option that delivers better valve performance than metering pumps with variable-linkage designs. The valve checks optimize performance because they have extra time to seat since they are idle during the by-pass portion of the suction and discharge strokes. The pumps have EZE-CLEAN™ Valves with cartridges that can be removed for cleaning without the need to disturb the pump's piping.

To quell material-compatibility concerns, Neptune offers the 500 Series pumps with a choice of materials of construction for the pump head, valves and seats, including 316 stainless steel, C-20, PVC and Kynar.® Valve checks are available in 316 stainless steel, C-20, glass or ceramic. The 500 Series pumps are capable of producing up to 94 gallons per hour (303 liters per hour) of flow at 100 psi of pressure (60 gph [227 L/h] if the pump is duplexed). Operational temperatures range from 125°F to 200°F (52°C to 93°C) with maximum pressures from 150 to 3,000 psi (11 to 210 bar).

Neptune's 7000 Series diaphragm metering pumps are mechanically actuated and have been designed to handle clear liquids with viscosities ranging from water-like to 5,000 cP, making them ideal for use in the municipal water and wastewater treatment applications. This ability is a result of the mechanical design that eliminates the use of contour plates on the liquid side of the diaphragm, combined with a straight-through valve and head configuration that delivers improved flow characteristics.

The capacity of the 7000 Series pumps is manually adjustable via micrometer dial while the pump is running. This allows the pump to produce flow rates ranging from 10 gph to 450 gph (38 L/h to 1,710 L/h) at head pressures up to 150 psi (10 bar). Liquid ends are constructed of PVC, and explosion-proof, variable-frequency drive and wash-down duty motor options are available. The pumps are also self-priming and provide superior performance when pumping chemicals that can contain small impurities such as sulfuric acid.



Neptune PZ Series Acid Skid Feed System with Containment

When choosing between a hydraulically or mechanically actuated diaphragm metering pump, the operator must take into account the specific needs of his operation. The 500 Series pumps utilize a PTFE disc that flexes between two perforated plates. Because the diaphragm is hydraulically balanced, the pump is capable of operating against higher discharge pressures than a mechanical diaphragm pump (like the 7000 Series), but the tradeoff is that the pump doesn't have the same suction-lift capabilities as a mechanical diaphragm pump. On the other hand, hydraulic diaphragm pumps, such as the 500 Series, offer built-in relief protection, which is especially desirable in high-pressure applications.

Finally, Neptune PZ Series electronic metering pumps are a viable option in acid-handling operations because they are able to offer stroke length and speed adjustments that make them particularly suited for low-flow acid-feed applications, which can require the pump to possess a wide turndown capability.

PZ Series pumps feature a "pulse" metering design that operates on any single-phase voltage from 94 VAC to 264 VAC, which is a crucial consideration if the pump will be operating on solar-powered batteries. The pump's manual stroke-length adjustment ranges from 50% to 100% with proportional control, cycle and counter functions built into the unit. PZ Series pumps are available with a PVDF pump head that is suitable for handling most acids.

Neptune also has extensive experience designing and fabricating acid chemical-feed systems. An advantage to working directly with the pump manufacturer for system requirements is the single-source responsibility for the supply and operation of all of the components within the chemical-feed system.

Complete chemical-feed systems from Neptune are available as factory assembled package units. These usually consist of a supply tank, agitator, pumps, piping, valves and electrical controls all mounted on a common frame or skid. These systems are generally shipped ready for installation at the jobsite and require a minimum number of field connections to make the system ready for operation.

In addition to the pumps, when feeding acids ancillary piping and accessory components must be carefully considered and selected, including:

- **Skids:** When practical, acid-feed skids should be constructed of corrosion-resistant structural FRP or polypropylene.
- **Strainer:** Diaphragm metering pump check valves operate best when the acid being pumped is clean and free of particulates, so the suction piping system should always include an appropriately sized strainer.
- **Calibration Columns:** These provide an inexpensive, yet reliable and accurate, means of verifying the pump's flow rate.
- **Injection Quill:** An injection quill or corporation stop injects the acid into the center of the pipeline, tank or process for more rapid and uniform chemical dispersion.

## Conclusion

As mentioned, water is critical to all forms of life and the successful operation of a wide range of industries. In conjunction with its use, the safe, clean and responsible treatment, conservation and disposal of water is becoming an increasingly critical issue across the country. Acids in



many forms play a correspondingly critical role in treating water and wastewater. Like water itself, proper care and handling of acids must also be observed. While operators of wastewater-treatment facilities are aware of the responsibilities they have in ensuring safe water sources, they also know that they must take every measure to optimize the cost-effectiveness of their operations.

That's where identifying and utilizing the most efficient and reliable pumping technology enters the picture. For more than 50 years, Neptune has been setting the industry standard in diaphragm metering pump technology. So whether a wastewater-management operation requires a hydraulic, mechanical or electronic diaphragm metering pump, Neptune offers the best array of choices via its 500 Series, 7000 Series and PZ Series product lines.

### About the Author:

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