Comparing Chemical Metering Pumps for Residential Well Water Systems

By Joe Dinovo, April 01, 2020

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More than half of the residents living in rural areas of the Southeastern U.S. use well water for drinking, cooking, gardening, laundry and other household uses. Residential water wells can range anywhere from a few dozen feet deep to more than 100 feet in order to reach the bedrock fractures that contain groundwater. Residential wells are typically lined with cement grout or bentonite clay; they are capped to prevent debris from entering at the surface; and all wells require pumps to deliver water into the home.

Well water in Florida, like many parts of the Southeastern U.S., is brackish in nature due to elevated levels of sulfur, iron and manganese. Hydrogen sulfide gas (H2S) occurs naturally in many wells, and it produces an unpleasant "rotten egg" odor. It enables bacteria to grow–which not only gives water and food a metallic taste but it can also clog and damage a home's plumbing.

To combat these issues, residential wells are fitted with chemical treatment systems that remove impurities in water. Much like water treatment in municipal plants, residential well water is disinfected via oxidation, using chemicals such as sodium hypochlorite or hydrogen peroxide. Water quality can vary widely from county-to-county and from well-to-well. Water quality analysis plays a key role in determining an optimal chemical solution for each well.

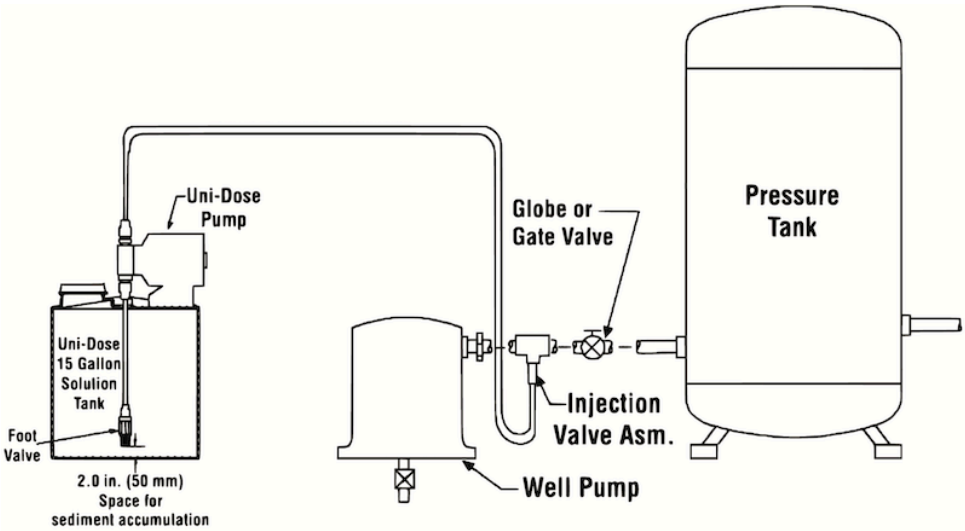
The systems built for home use typically include: tanks to store chemicals; metering pumps to deliver the right amount of chemical; tubing and electrical connections; and a variety of filters. Initial filtering removes sand and sediment prior to the chlorination process. After the chemicals have been dosed, activated carbon filters within the home (closer to the tap) remove excess chlorine. Some systems also include resin filters and reverse osmosis (RO) filters.

These systems are built, installed and serviced by licensed contractors. The ecosystem that pulls all the pieces together typically includes equipment manufacturers (such as Uni-Dose Pumps) that design the metering pumps; master stocking distributors (such as Florida-based Fluid Systems & Controls) who deliver and service the pumps; wholesalers who assemble the skids and provide the tubing and electrical connections; and the licensed contractors, who are also the "water doctors" that determine the optimal chemistry for the well, and restock the chemicals on a monthly basis.

The Metering Pump is the Heart of the System

Chemical metering pumps are used to draw highly concentrated chemicals from storage tanks and deliver a precise volume of chemicals into larger tanks where well water enters for disinfection. Coming directly out of the chemical tank, sodium hypochlorite is usually dosed around 12.5% concentration, while hydrogen peroxide is typically dosed at a 7% ton 10% concentration. These chemicals are extremely harsh in nature. At such concentrations, they would burn skin, irritate eyes or cause respiratory issues if inhaled.

Fortunately, once a chemical like hydrogen peroxide mixes with water in the larger tank, it immediately decomposes into oxygen and water, eliminating the bacteria and leaving no trace of chemical residues. But until it is delivered into the water tank, it is imperative that the metering pump transporting these chemicals does not leak. This point



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in the process is the critical point-of failure for the entire system–so the liquid end of the metering pump must be constructed of materials that can withstand these harsh chemicals for years.

Comparing Diaphragm & Peristaltic Pump Designs

When choosing a metering pump for residential well water systems, there are two leading pump designs and each has their strengths and weaknesses.

Peristaltic pumps are positive displacement pumps that move fluid through flexible hoses or tubes fitted inside the pump casing. A rotating shoe or roller passes along the length of the hose/tube creating a temporary seal between the suction and discharge sides of the pump. As the pump's rotor turns, this sealing pressure moves along the tube or hose and forces chemicals through the pump and into the discharge line. Once the pressure is released, the hose or tube recovers to create a vacuum which draws chemicals into the suction side of the pump.

Peristaltic pumps offer an open flow path, which permits an easy flow of solids and highly viscous chemicals. They are well-suited for pharmaceutical or food and beverage applications where substances pumped are not hazardous. The inherent weakness in peristaltic designs is the fact that they require a forceful squeeze of the rollers against the hose/tube in order to prevent slippage or leaks. This hard squeeze is ultimately what damages the hoses and prompts their replacement. It is not a matter of if a tube/hose fails but when that failure will occur.

When dealing with harsh and hazardous chemicals such as sodium hypochlorite or hydrogen peroxide, leak-free operation, safety and reliability are paramount–particularly with residential systems where pumps and tanks are not monitored on a daily basis by trained engineers. The characteristics of safety and reliability are more readily available in diaphragm pump designs.

Diaphragm pumps feature a piston which creates a vacuum that pulls chemicals into the pump's liquid end from external tanks. Alternating piston strokes create pressure that closes the inlet valve, opens the outlet valve and forces the chemical out to the process. Within the liquid end is a diaphragm, which acts as a barrier between the piston and the process fluid. The piston's pumping motion causes the diaphragm to flex back and forth. The more the diaphragm flexes the higher the flow rate for the pump. The rate of flow can be precisely controlled to ensure that the process receives just what it needs, without over/under injecting.

The liquid end (or the "wetted" part) of a diaphragm pump is known for its ability to protect people and the environment, making diaphragm pumps a preferred choice for dealing with toxic or hazardous chemicals. A wide variety of construction materials that are used in industrial pumps are available for residential well water systems depending on the application's specifications, which include temperature, flow rate, fluid viscosity and the corrosiveness of the materials that will be pumped.

Durability for Outdoor Deployments

Most of the residential well water treatment systems deployed in Florida are located outdoors. The ability to stand up to searing temperatures during the day should be considered when choosing a pump. Today's latest magnetically actuated solenoid pumps feature enclosed NEMA 4X/IP65 housings with UV and heat resistance up to 122°F. Universal 115-230V, 50/60Hz power supplies should include internal varistors and fuse protection to protect the pump from power surges or lightning strikes, which surprisingly cause a high percentage of pump failures.

Simplicity is the Key to Streamlined Maintenance

Distributors, such as Fluid Systems & Controls, have provided tens-of-thousands of diaphragm metering pumps to Florida residents. The average pump lifespan varies widely, from five to 10 years.

"The majority of service calls come from homeowners that have 'tinkered' with pump set points when the pump is off, which in some cases causes the pump to lose calibration," said Fluid Systems & Controls' Brad Hansen. "This can result in over injecting chemicals, which wastes money, and depletes stocks ahead of schedule, prompting service calls. It can also result in under treatment, which leaves a metallic taste in the water, causing residents to further adjust the pump's set point or call their licensed contractor."

Today's metering pumps alleviate most of these problems with new interfaces that make them easier to operate, diagnose and maintain. A single speed control knob provides easy, accurate adjustment over the pump's entire operating range, offering precise capacity control from 1 to 24 gallons per day at up to 80 psi. The latest generation of pumps is easy to install, featuring new priming valves that allow for quick and easy start-up. This is important because unlike municipal disinfection systems that are closely monitored by skilled engineers, the interfaces on residential well water systems must be intuitive, easy to operate, and they should provide a basic layer of protection that makes it hard for non-technical homeowners to create problems.

Unawareness is Bliss

Much like an HVAC system, a residential well water treatment system is doing its job when residents are not even aware of it. The pumps that power today's systems are quiet with advanced noise reduction capabilities and superior reliability that enables them to dutifully do their jobs without anyone noticing.

Some brands have been providing solenoid pumps to residential customers for decades. During this time, they have garnered extensive experience and customer feedback that has led to better, more reliable pump designs with features that make it easier to operate and maintain. The result is a new generation of pump that is specifically designed for residential well water systems.

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