The Case For Metering Pumps In Power Generation

POWER-PLANT WATER-HANDLING OPERATIONS THAT REQUIRE FERRIC SULFATE AND SULFURIC ACID ARE FINDING SUCCESS WITH THE USE OF NEPTUNE™ DIAPHRAGM METERING PUMPS

By Tom O'Donnell and Bill Ehrhardt

Power plants create enough electricity to power thousands of homes and businesses on a daily basis, but only if ultra-pure water is used. Hydraulically Actuated Diaphragm Metering Pumps from Neptune™ help ensure that the critical compounds used to create this ultra-pure water are dosed correctly.

Most of us would recognize, from a distance, the hulking industrial facilities that are known as power plants, with their rows of cooling towers that allow the waste heat energy, in the form of water vapor, that is a byproduct of the power-generation process to be vented to the atmosphere. The interior of a power plant is just as daunting, with a series of pumps, clarifiers and filters used to take common water from a river, lake or aquifer and turn it into ultra-pure water that must be sent through a boiler that converts that water into the steam that drives the turbines to create the electricity that is used to power thousands of homes and businesses.

While the gallons of water required for all power plants in the United States totals in the trillions of gallons each year, with most used for cooling, other components in much more precise measurements are required to transform the water into ultra-pure water for the boilers. These compounds commonly include ferric sulfate and sulfuric acid. Ferric sulfate is a crystalline salt that is soluble in water and used as a coagulant; in power plants, it helps remove solid particulates from water. Sulfuric acid is a highly corrosive and toxic strong mineral acid that is soluble in water at all concentrations; in a power plant, it is used to control the pH, or alkalinity, of the water that is used in the boilers.

Ensuring that the proper doses and flow rates of ferric sulfate and sulfuric acid are reliably achieved is a key concern for the power-plant operator. This white paper will illustrate why a specific type of pump technology—hydraulically actuated diaphragm metering pumps—is the best choice to ensure that the proper concentration and flow of ferric sulfate and sulfuric acid are consistently realized, in the process guaranteeing that the water used in power generation meets the high levels of purity that are required.

The Challenge

The purification of the water that is needed for power generation occurs through a number of specific operational stages. The first is the water's passage through a clarifier, where any large, solid impurities are removed. From there, the water travels through a filter, where any dissolved solids (not visible to the naked eye) are removed. These initial pre-treatment stages are critical because from there the water moves through a demineralizer, which cannot handle water that contains any solids.

When water is demineralized, it means that most positive and negative ions are removed, in effect creating an essentially ion-free solution. This is another critical stage in the power-generation process, because only demineralized water can be heated up in the boilers and used to create the steam that generates electrical power.

The ferric sulfate is used in the clarifying and filtering stages of power generation. Since it is a coagulant, it interacts with any solid particles in the water and causes them to "clump" together, which makes it easier for the particulates to be removed from the water. The sulfuric acid is used in the demineralization process as a way to balance the pH level of the water so that it achieves that "neutral" state that is required before it can be heated. Users of sulfuric acid must also be cognizant of its harmful effects; for example, blindness can result if it is splashed into eyes, while contact with the skin can result in severe chemical burns. It is therefore imperative that sulfuric acid be properly and fully contained during its handling, transfer and use.

Though thousands of gallons of water are going through the clarifiers, filters and demineralizers on an hourly basis, the amount of ferric sulfate and sulfuric acid that is introduced to the process must be precisely controlled. In other words, if the process calls for 2.5 gallons per hour (gph) of ferric sulfate to be used, that means it has to be 2.5 gph, not 2 or 3 gph. The same goes for the doses of sulfuric acid that are required.

For these critical dosing applications, most power-plant operations feature skids with chemical-feed pumps that have electronic stroke controllers following a 4-20 MA signal (which allows automatic adjustment of the pump capacity) for feeding the chemicals. The challenge for the power-plant operator is to identify and deploy the best pumping technology for the operation, namely one that can reliably and repeatedly inject the precise amount of ferric sulfate and sulfuric acid, without leakage or spillage.

The Solution

Over the years, it has been determined that the hydraulically actuated diaphragm metering pump possesses the operational capabilities and reliability to perform these crucial operations within a power plant. Metering pumps are perfect for these applications because they can be dialed in to meet specific flow and dosage parameters, which are the lifeblood of a power plant's water-purification process.

Within the realm of the metering-pump universe, the standout technology is the 500 Series Hydraulically Actuated

While power plants use thousands of gallons of water per day when generating electricity, operations are only completed successfully when precise doses of ferric sulfate and sulfuric acid are injected into the water-purification system. Neptune™ hydraulically actuated diaphragm metering pumps can help ensure that those dosage rates are consistently and reliably met.

Diaphragm Metering Pump from Neptune Chemical Pump Company™, North Wales, PA, USA, a product brand of PSG®, Oakbrook Terrace, IL, USA, a Dover company. Over the years, Neptune has built a reputation as a leading supplier of hydraulic diaphragm metering pumps for use in conjunction with boilers and cooling towers in power plants.

Neptune™ 500 Series Diaphragm Metering Pumps feature a Variable By-pass™ stroke adjustment that allows more accurate valve performance than competitive variable-linkage designs.

The Neptune 500 Series pumps separate themselves from the competition because they feature a design with a unique Variable Oil By-pass™ stroke adjustment that allows better valve performance than competitive variable-linkage designs. The Variable Oil By-pass design gives the valve checks extra time to seat since they are idle during the bypass portion of the suction and discharge strokes. Desired flow rates are achieved through the incorporation of a highly accurate 10-turn micrometer dial that can be calibrated to 1% increments. All pump sizes in the Neptune 500 series have a repeatable accuracy of +/- 1% of full scale over the range of 10% to 100% of capacity.

More specifically, Neptune has found great success in the implementation of the 500-S Series metering pump in power-plant applications. The features of the 500-S series pumps that make them ideal for the proper injection of ferric sulfate and sulfuric acid include:

- Double ball-check design
- Ability to be used in simplex or duplex configurations
- EZE-CLEAN™ valves with cartridges that can be removed for cleaning without disturbing the pump's piping
- Color-contrasted dial protected from corrosion by clear PVC covering
- A stroke mechanism that moves only when adjusted, which eliminates wear
- A piston that is powered through the complete stroke length at all capacities, eliminating stress, wear and shock
- Built-in internal relief valve
- 316 stainless steel, C-20, PVC materials of construction for valve body and seats
- 316 stainless steel, C-20, glass materials of construction for valve checks
- PTFE diaphragms
- Gear speeds up to 144 strokes per minute
- Maximum temperatures of 200ºF (93ºC) for stainless-steel and C-20 models, 125ºF (52ºC) for PVC models
- Flow rates up to 30 gph or 60 gph duplex (114 L/hr or 228 L/hr duplex)
- Maximum flow pressure of 3,000 psi (207 bar)

For power-plant operations that may require higher pumping pressures, Neptune offers the 6000 Series Hydraulically Actuated Diaphragm Pump, which can produce pressures up to 4,000 psi (276 bar). The 6000 Series pumps also offer all of the standard-setting features of the 500 Series models.

Additionally, Neptune offers operational Calibration Columns, which are a fast and economical way to calibrate the flow rate of the pump, and Pulsation Dampeners, which remove the pulsation created by the pump's reciprocating action, ensuring a smooth, laminar flow. Also, Injection Quills provide uniform dispersion of chemicals to the injection site, while Relief Valves can be placed on the discharge piping in case blockage occurs in the pump's discharge line.

Neptune™ Hydraulically Actuated Diaphragm Metering Pumps that are used in a power plant's water-purification system have the ability to be controlled via micrometer dial, which allows the user to accurately set the dosage rate.

Proper water clarification and purification is critical to the successful operation of a power plant and Neptune™ 500 and 6000 Series Hydraulically Actuated Diaphragm Metering Pumps offer the operational characteristics that guarantee the precise dosing of chemical compounds in these vital processes.

Conclusion

Without power, the world would cease to exist as we know it. That makes its consistent and reliable generation one of the foundational blocks of human existence. Within power generation, though, a number of specific, precise steps must be taken to ensure that the process goes off without a hitch. Chief among these steps is the clarification and purification of the water that is used in boilers to create the steam that aids in the production of electrical energy. This water must attain exacting levels of purity and that purity can only be achieved through the use of chemical compounds such as ferric sulfate and sulfuric acid. To ensure that these critical compounds are injected into the power-generation process in the correct doses, power-plant operators are relying on hydraulically actuated diaphragm metering pumps, with Neptune's 500 and 6000 Series models proving to be the best choice for these highly critical dosing applications.

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