Rotary Gear Pumps:

Chemical feed water treatment applications at nuclear power plants

Nuclear power plants are typically located near an abundant water source because they can use up to 500,000 gallons of water per minute.

Huge quantities of water are used in nuclear power plants for a variety of operations. As such, there are a number of chemical processes that the water has to go through before it can be released back into the environment. When it comes to water treatment applications, small rotary gear pumps can be used as a means of improving performance rates, maintenance and costs.

By Karen Eisemann, Director of Customer Service / Rotary Product Manager, Pulsafeeder Engineered Products

There's a reason nuclear power plants are located near an abundant water source, such as a river, lake or an ocean. It is because they typically pump more than 500,000 gallons of water per minute through heat exchangers in their circulating water systems. These systems cool the plant's condensers and they remove heat from the steam that exits the plant's main turbine. Nuclear plants also have service water systems that are used to cool air compressors, lube oil systems and other systems related to the safe shutdown of the reactor. Without enormous quantities of water, nuclear power plants cannot operate. However, quantity alone is not all that matters – the quality of the water has a direct impact on the plant's efficiency. That's why all of the water used must be filtered and cleaned during use and before being discharged back into the environment.

The initial screening comes from large external filters that trap large debris. Once the water has entered the plant's circulating system it must be cleaned via chemical feed processes in order to manage micro-bio organisms and to prevent scaling, corrosion and foulants from hindering the efficiency of the condenser.

Clean condenser heat transfer surfaces have a direct impact on a plant's operating efficiency and failing to prevent micro-bio fouling can lead to expensive plant de-rates and unplanned outages. To clean the water, chemicals such as sulfuric acid and sodium hypochlorite solutions are metered via rotary gear pumps. These applications feature exceedingly high flow rates and relatively low pressures.

Traditional demineralizer systems are also utilized in the power industry to purify water for the steam generating loop. These systems remove contaminants that can negatively affect the steam generator's performance. Large ion exchange resin beds remove contaminants by substituting H+ ions and OH- ions for dissolved salts in the source water. The resultant water is pure and essentially free of any dissolved salts. When exhausted, the resins are re-generated by using sulfuric acid and sodium hydroxide. This re-generation requires large dosing rates at relatively low pressures. After the water is used it is discharged back into the environment, but before doing so, it is treated with a de-chlorination chemical, such as sodium meta-bisulfite. In cases where high dosing rates are required, the de-chlorination chemicals can be metered out by rotary gear pumps.

Today, many nuclear power plants are realizing that they can save money and streamline operations by replacing larger, and more expensive, diaphragm pumps with smaller rotary gear pumps for the following reasons:

Performance - Gear pumps are specifically designed to address high flow rates and deliver uniform, pulse-free dosing.

Reliability – Chemicals such as sodium hypochlorite tend to off-gas when they come in contact with metal surfaces. However, non-metallic gear pumps feature a simple design that helps prevent off-gasing, which minimizes disruptions and helps to maximize uptime for water treatment operations.

Safety - Because exposure to chemicals such as chlorine gas can cause respiratory issues for employees, great care should be taken to ensure that leaks do not occur when dosing hazardous chemicals. Sealless gear pumps offer fewer points of failure because there are no leak points for harsh chemicals to damage the pump or the surrounding equipment.

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Streamlined Maintenance – Easy access to the inner workings of a gear pump enables it to be maintained in place, which minimizes downtime by eliminating the need to lock out/tag out the pump and move it to the repair shop. The simpler the design is, the easier the pump is to maintain. This gives plant operators greater flexibility to schedule maintenance between shifts, or whenever it is least disruptive to do so.

Smaller Footprint – Rotary gear pumps are compact in nature and they don't require as many ancillary items as diaphragm pumps do (such as pulsation dampeners), so the overall size of the equipment package can be reduced.

When it comes to treating water in nuclear power plants, both reciprocating and rotary pumps can do the job. Yet, in many instances, plants can save money and gain new efficiencies by using rotary gear pumps for certain chemical feed water treatment applications.

About the Author

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