Technical Publication

How To Extend The Life Of Your Wastewater Pumps

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Wastewater treatment plants use numerous pumps in a variety of types and sizes to move water through the process. Depending on plant configuration, they may pump influent, activated sludge, thickened or digested sludge, biosolids, scum, filtrate, effluent, or reuse water. Each matrix has specific characteristics that engineers consider when designing pumping systems.

These wastewater pumps are very expensive, typically costing more than $5,000 per pump. Emergency repairs often include overtime costs, which can add on hundreds of dollars depending on the size of the emergency. The loss of a pump is not only costly, but it also puts the facility at risk of violating regulations. Even though permit violation costs are often budgeted in, facilities would prefer to avoid such fines. Protecting pumps from damage saves money and protects the environment.

Pump Problems From Dry-Running

Dry-running a pump means operating the pump with no liquid. Some pumps, like screw pumps or rotary lobe pumps, can tolerate dry-running, but centrifugal wastewater pumps cannot be run dry. These pumps depend on the pumped liquid to cool the components. When run with insufficient or no liquid, excessive heat can result in damage to the pump seals, bearings, impeller, and shaft. The cost of replacement parts can quickly add up to thousands of dollars, and double that when maintenance work on the pump is added in. Catastrophic failure of the pump may occur.

Causes Of Dry-Running

Sewer Clogs

Most treatment plants remove debris from the influent wastewater with screens or bars. However, some amount of stringy material, hair, and wipes may still enter the treatment process. Grease may also be entrained in the raw wastewater.

The combination of grease, hair, and debris can form "rag balls" that create clogs in the plant piping or in the pump. These debris balls form over long periods of time. Operators may or may not be able to notice reduced flows until the level is low enough to affect the pump.

Some of the most sensitive areas for clogs occur in pipes conveying thicker materials, such as scum or thickened sludge. Another common location for sewer clogs would be an influent pumping station or master lift station.

Over-Pumping

Some instances of dry-running occur due to operator or electronics error. For instance, an operator may turn on a pump, then respond to an alarm elsewhere on the plant site. The pump continues to run until the tank or wet well is empty, creating a dry-run condition.

Another example would be where an automated pump cycle fails to shut the pump off due to faulty electronics or programming errors.

How To Prevent Pump Damage From Dry-Pumping

Ensuring proper screening and debris removal at the headworks is a first step toward protecting pumps at the treatment plant. However, even with the best equipment, some grease, debris, and hair will enter the plant. A March 2015 article in *Water Environment & Technology*, titled "It's the fibers: Attacking the wipes problem at the pump station," described a research project that found hair to be the key catalyst for forming debris balls.

Inadvertent over-pumping due to automation failure or operator error is even more difficult to prevent. Therefore, additional protective measures should be taken. Pump manufacturers and engineers have recommended various ways to monitor for loss of flow.

Power Monitors

Measuring the current draw of the pump's motor can indicate that the pump is running dry and signal for it to turn off. Similarly, torque on the drive shaft can be measured and used to shut off the pump if there is no resistance. While these methods reliably measure over or underloaded conditions, they rely on measuring what is actually in the pump. The alarm and shutoff could occur after the pump has started to run dry, and the pump could still be damaged.

Pressure Switches

Pressure switches measure reduction in head, which indicates the pipe is emptying. They are effective at shutting off the pump prior to dry conditions. However, their reliability is questionable, as they are susceptible to plugging and fouling.

Flow Switches

Flow switches can be installed in piping upstream of the pump to allow time for shutdown before a dry-pump condition is reached. They can determine whether there is any flow or whether the flow is above or below a setpoint. Several types of flow switches are available.

Mechanical flow switches, such as paddle switches, are unfortunately sensitive to wear and corrosion damage.

Ultrasonic flow switches have no moving parts and are easy to install. However, their accuracy may drop at low flow rates. Also, pitting or fouling of the pipe may affect flow readings.

Thermal dispersion flow switches, like FCI's FlexSwitch® FLT93 series, can measure both a low flow and lack of flow. Look for a switch with dual alarm capacity. When flow reduces to a setpoint, it triggers an alarm. The operator can check the system and reset the flow switch after determining the cause of the problem. If the line actually runs dry, a second alarm rings and the pump is immediately shut down.

These thermal mass flow switches are dual-function meters. They can measure temperature, flow, and/or level in one device. They are available in in-line or insertion styles and are ruggedly constructed for use in wastewater.

Keep Your Pumps Safe

By monitoring flow to prevent dry-run conditions, you can extend the life of your pumps. In addition to the cost savings, you can avoid noncompliance with regulatory limits. Operators will be happy to not come to work in the middle of the night. And most importantly, you can protect our sensitive environment. ■