Gas Chlorination Safety News™

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Special Gas Chlorination System Replaces Tablet System at WWTP, Providing Enhanced Safety Needed for Gas Option, While Cutting Chemical Costs

Disinfection System Replacement a Key Part of Major Plant Reliability and Efficiency Upgrade

Special gas chlorination system significantly enhanced safety for gas option for disinfection, while offering other unique components and controls for reliability and efficiency.

The JCS Robo-Control automatic shutoff system, left, is electrically operated, and provides for battery backup. It remotely closes valves, and mounts without interfering with other mounted hardware. The gas vacuum chemical feeder, right, includes a control module for complete electronic control and communications. Available control modes include flow proportional, residual, and compound loop.

The district manager for the Pinetop-Lakeside Sanitary District (AZ) reports that a special gas chlorination system, featuring unique components and controls, and manufacturer-supplied service, has effectively replaced a chlorine tablet system. The disinfection system replacement was a key part of a major reliability and efficiency upgrade for their 2 MGD activated sludge wastewater treatment plant (WWTP).

The upgrade has featured significantly enhanced safety for the use of chlorine gas for disinfection, while providing dramatically reduced chemical and energy costs. In particular, special automatic valve shutoff actuators shut down the gas system upon leak detection, a key feature that allowed for re-evaluation of chlorine gas as the most cost-effective method for disinfection, despite the added cost of the actuators.

"Our original 1980 plant (0.5 MGD) was upgraded in 1988, and while we were still in compliance and accomplishing our treatment goals, we felt some of the equipment was nearing the end of its useful life," recalled David Smith, the district manager. "We wanted to be proactive in upgrading, and not wait for a catastrophic failure that could put our employees or community at risk, or have us end up in a position of the state telling us what we had to do, most likely at a higher cost than what we might come up with ourselves."

"We did our own investigation of alternatives, and also got a lot of input from a rep we had known for awhile, to help put the changes together. We needed the level of trust we had in him, since we knew that some sales reps just try to sell you the most expensive equipment they can get, and we needed a high level of confidence with safety, as a real concern for using gas over tablets. With the plant upgrade overall, we were also especially interested in reducing energy and chemical costs."

Plant Operation

The 2 MGD plant serves about 8000 connections, mostly residential, with about 300 commercial. Average flow ranges from 0.8 MGD to 1.3 MGD during the winter ski season and summer months.

Flow enters the plant through a quarter-inch step screen in the headworks, and is then pumped to vortex grit removal and discharged to an oxidation ditch. To improve energy efficiency, coarse air jet aeration in the ditch, which featured a high-energy pumps and blower setup, was replaced in the recent upgrade with a fine bubble membrane diffuser system, with blowers controlled by variable

frequency drives (VFD's), and a submerged propeller system to "keep everything in suspension."

After biotreatment, the stream proceeds to a clarifier, where excess solids are removed for composting. For subsequent disinfection by chlorination, the plant had been relying on a tablet system.

Replacement Chlorination System

"A big problem with the tablet system was that we were not only paying $2.40/lb., but only 68% of the tablet was chlorine," Smith said. "That meant we were actually paying $3.53/lb. for available chlorine. With the new system, the gas is costing us only $1.26/lb., including all the extras like trucking, cylinder rentals, and surcharges."

"Based on our chlorine usage during the first month and a half, we're hoping to save as much as $40,000 annually on chemical costs. We are also getting more consistent dosage with the gas system, for more reliable chlorine input to meet our state compliance requirements. And our safety margin, which is a concern for any use of chlorine, has improved."

He explained that when the tablets in the bottom of the tank were in contact with the water supply, they would erode and supply the needed chlorine. But there would be times when the eroded tablets would form a bridge, not allowing the continuation of tablets to be eroded, and the result would be that no chlorine would be provided for disinfection. The solution would be to use a broom handle to break down the bridge holding the tablets up, and preventing them from contact with the water.

Regarding compliance, the primary parameter of interest to the Arizona Dept. of Environmental Quality (ADEQ) is control of fecal coliform, which is limited to 200 colony forming units (cfu's), or 200 MPN (most probable number). The relatively high threshold derives from the water body type being "discharged to a marsh;" i.e., a wetland with no discharge; just evaporation and percolation. Smith estimates the MPN entering the plant as "probably tens of thousands."

Special Chlorination System Components

Working with his sales rep, Ron Clark of Applied Products Group of Scottsdale, AZ, Smith got approval from his design engineering firm, PACE of Scottsdale, AZ, to use special equipment, instead of the firm's regularly specified equipment, for a chlorine delivery system based on four 150-lb. gas cylinders (bottles).

Automatic vacuum regulators, with switchover, have electric motors that rotate valve stems toward open or closed position for alignment, tests, and remote operation. There are no large signal cables.

Chlorine is injected into the clarified wastewater stream, through a water supply line that creates a Venturri (suction). System controls allow for chlorine dosing from 65 lbs. down to whatever is needed at a given time. In addition to meeting design requirements effectively and efficiently, the system incorporated safety features for protection of personnel and equipment in the event of a chlorine leak.

Two banks of cylinders are set up on two scales, one cylinder on each, with an automatic vacuum regulator on each set. The vacuum injector closes when cylinders are empty, and automatically switches flow over to the other two cylinders.

Upon detection, a leak detector causes automatic valve actuators to shut down all four cylinders, open an exhaust fan, and activate a siren, while a beacon above chlorine storage further alerts workers. The atmosphere in the equipment room is continuously monitored.

Cylinders were manifolded together to help minimize project cost by avoiding the need for a regulator on each cylinder. The setup can be expanded to four cylinders on each side.

The banks of cylinders are set up on pressure headers, so that chlorine is withdrawn equally from either side. At the end of each header is an automatic switchover vacuum regulator, with dedicated drip leg and heater. One cylinder on each bank is independently measured on the scale, which displays the total sum of each bank of cylinders.

The same manufacturer supplied the leak detection system, the emergency shutoff actuators, the scales, the chlorinators, the vacuum regulators, and the vacuum injector, all of which are USA-made.

"We noticed that various components manufactured by JCS Industries were built with thicker material, giving us confidence they were less prone to warping and failure than alternatives," Smith noted. "The injector in particular seemed stouter and more substantial in comparison. When that component fails, you get leaks."

"As part of our own research on the equipment," Smith continued, "we were very pleased to see that they not only manufactured their equipment, but offered repair service for it, as opposed to other companies, who sent out for that. We concluded they had more control of their products, from manufacturing through use and service, and we now have more consistent and controllable chlorine application for disinfection."

"We also noticed that the only previous manufacturer for the automatic shutoff valve actuators required them to be sent out every year for torque recalibration, while this one didn't require that. So we could get the same reliability on a more cost-effective basis. "

Component Features

JCS Industries' gas vacuum chemical feed controller is comprised of a vacuum injector to safely introduce the gas for disinfection of the clarified waste stream; a reversing servo motor coupled with a V-notch valve to regulate the chemical flow rate; and a control module for complete electronic control and communications. Available control modes include flow proportional, residual, and compound loop.

The JCS Robo-Control automatic shutoff system is electrically operated, and provides for battery backup operation. It remotely closes valves, and is specially designed for mounting without interfering with other cylinder-mounted hardware.

Like the automatic-switchover vacuum regulators, it has an electric motor that rotates the valve stem toward open or closed position for alignment, tests, and remote operation. There are no large signal cables, and it can be radio-operated. It eliminates the need for costly scrubbers in certain applications, per the Uniform Fire Code.

The gas leak detector is designed to monitor trace amounts not only of chlorine, but of other gaseous water treatment chemicals, including ammonia and sulfur dioxide. It activates an alarm when gas levels exceed programmed maximum rates. It can monitor up to two different gases simultaneously with each main controller.

The electronic cylinder scale is specifically designed for weighing 150-lb. compressed gas cylinders, with another model available for weighing the 2,000-lb. type. A formed, three-sided curb aids in proper alignment, while a unique, hidden hinge design allows for workers to easily lift and remove the platform for cleaning. The scale can be set up for single or dual cylinder operation, with independent analog or adjustable outputs.

JCS Industries' chemical feed system components and systems are available not only for dosing chlorine gas at a range of flow rates, but also a variety of aqueous chemicals commonly used at various rates in municipal and industrial water treatment systems.

For further information, contact JCS Industries,
5055 FM 2920, Spring, TX 77388, Tel. 281-353-2100,
Fax 281-353-0657, sales@jcsindustries.us.com,
www.jcsindustries.us.com.

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