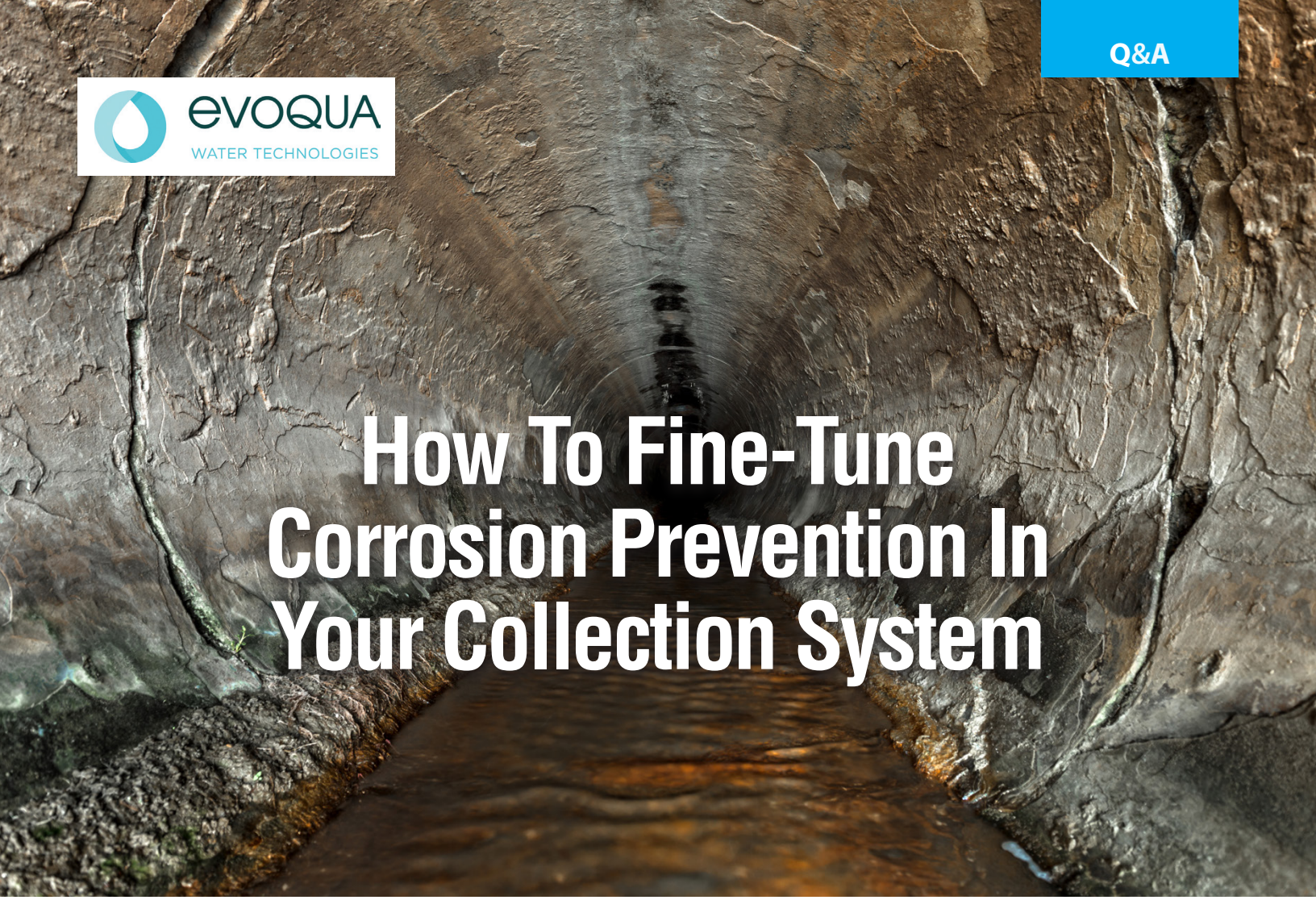

How To Fine-Tune Corrosion Prevention In Your Collection System

Many utility managers have experienced infrastructure failures caused by corrosion in the collection system — corrosion that leads to sewer collapses, weakened wet wells, and control system failures. These issues are often not addressed until complaints about overflows or odors are received from regulators or customers.

Evoqua Water Technologies is a global leader helping utilities protect water infrastructure. Water Online spoke with Jennifer R. Miller, VP & General Manager Municipal Services for Evoqua, to learn more about collection system corrosion and how to mitigate the problem.

How does hydrogen sulfide cause corrosion?

Hydrogen sulfide is a naturally occurring compound in wastewater collection systems. In acidic or turbulent conditions, hydrogen sulfide is released as a gas. Thiobacillus bacteria react with and oxidize hydrogen sulfide gas to form sulfuric acid. This acid corrodes pipes and structures and may cause failures leading to sewer pipe collapses and overflows. This is known as microbial induced corrosion (MIC) because bacteria are producing the chemicals that react with the structures and cause corrosion.

What factors in the collection system affect the formation of hydrogen sulfide?

Multiple factors in collection systems affect the formation of hydrogen sulfide and, therefore, the rate of corrosion. Typical factors are based on either system design or wastewater characteristics. With system design, contributing factors may include force main length and diameter, hydraulic retention time, daily flow patterns, turbulence, topography, and location. The time of day and season influence wastewater characteristics — wastewater pH, temperature, biochemical oxygen demand (BOD), sulfate concentration, and flow rate.

What is the impact on the collection system?

When left untreated, sulfuric acid breaks down concrete and metal infrastructure, shortening the life of the collection system. The failing system leads to sewer collapse and overflows, resulting in costly repairs, demands on emergency services, and negative exposure for the plant. More importantly, collection system failures cause serious health risks to plant employees and the community. Working in confined spaces is especially dangerous to the employees due to the toxic nature of concentrated hydrogen sulfide gas.

Have there been any studies to show the impact of hydrogen sulfide corrosion in collection systems?

The EPA provided a report to Congress that estimated $6 billion (1991 dollars)

would be needed for collection system repairs. More than 80% of that cost was for sewer rehabilitation, primarily from hydrogen sulfide corrosion. Evoqua completed a two-year study on the effects of hydrogen sulfide on concrete pipes. Two geographically close points were compared with one point as a control. In the treated system, there was a time-weighted average of 3.6 ppmv of hydrogen sulfide versus 68.5 ppmv in the untreated system, a considerable difference. Over a two-year period, concrete test cylinders were deployed at the discharges of the two force mains with samples taken every six months. Mass measurements were compared to determine the impact of hydrogen sulfide corrosion. The concrete test cylinders from the treated system showed a negligible decrease in mass and compression strength. In the untreated system, there was a 5.4 % decrease in mass and a 13% decrease in strength, reducing the life of the pipe.

Hydrogen sulfide is also highly corrosive to any reactive materials, including iron pipe and control systems. It's easy to see that if not treated, hydrogen sulfide corrosion will reduce the useful life of the collection system. Unfortunately, it's often odor control that is noted as the primary problem rather than the useful life of the system.

What other problems are caused by the formation of hydrogen sulfide in collection systems?

Most important is the impact on human health. Hydrogen sulfide has a characteristic rotten-egg smell, and creates a nuisance odor, but it is also a risk to health. At 10 ppm, headaches and sore throats can occur. At 100 ppm, olfactory paralysis occurs, which means you lose your sense of smell and can't detect the gas. In worst-case scenarios, employees in confined spaces encounter concentrations that lead to death, with some cases occurring within the last year. We sometimes forget about the effects on human health. We should take this issue more seriously as an industry.

Are there ways to monitor the amount of hydrogen sulfide in the collection system?

Yes, several technologies are on the market that measure hydrogen sulfide gas levels. Fixed systems placed in plants and lift stations measure levels for human protection. Portable field meters are often used, along with VaporLink® hydrogen sulfide monitoring technology. With VaporLink monitors the hydrogen sulfide data can be transmitted remotely to any Web device for easy access to current levels.

This technology is used for monitoring and control, integrating the devices as part of an effective corrosion and odor control program. The data is used to understand trends in the hydrogen sulfide levels over a period of time. Utilities can adjust real-time treatment strategies to meet their system goals. We know characteristics can change daily or hourly — so constant monitoring is required to create the most effective program.

How can corrosion be mitigated?

There are multiple methods available to utilities to mitigate corrosion.

Utilities can avoid the effects of corrosion by choosing or changing the materials of construction in the system. This method includes wet well lining, installing pipe liners, or using acid-resistant plastic pipe for new or replaced piping. However, in most cases it's impractical or too expensive to modify an entire system, especially for large utilities. Corrosion-resistant components may also be used in lift stations, but that doesn't help to reduce health risks associated with hydrogen sulfide gas. In most cases, a utility still needs additional mitigating technology.

In our experience, chemical treatment to reduce hydrogen sulfide is presently the best technology to mitigate corrosion. Various chemicals are used for hydrogen sulfide mitigation. Chemical reactive oxidizers are one solution. Nitrate solutions will biologically prevent formation of hydrogen sulfide. pH-shifting chemicals prevent hydrogen sulfide from entering the atmosphere. And iron salts react with sulfide in ionic form to precipitate the sulfide. These are all common chemicals with known environmental profiles. Utilities have a wide range of mitigation methods available and should work closely with their supplier to find the right solution to address their specific problems.

What are some advantages and disadvantages of the various solutions?

There is no one solution to address the problem of hydrogen-sulfide related corrosion. And there are not necessarily advantages or disadvantages to each solution.

Each potential solution is an individual tool. How well the tool works depends on the details and dynamics of the specific application and collection system. For example, hydrogen peroxide is very effective for systems with short retention times. However, it may not be economically viable for systems with longer retention times since more product is needed, resulting in higher costs.

Another example is a class of chemicals known as pH shift solutions. These chemicals treat the total wastewater flow, independent of sulfide mass, while other products treat based only on sulfide mass. So, the most effective and cost-efficient solution depends on how much sulfide is present, the wastewater flow rate, and the specific treatment goal.

Other issues may involve handling concerns for different products or the location of the issue. For instance, a utility may not want to have an aggressive chemical stored near a school. Considerations may also include capital requirements and type of equipment needed. No one size fits all, so a combination of products may be needed to reach the right solution.

How can a utility determine the best and most cost-effective solution for corrosion control in their collection system?

Utilities must ensure they are applying the most appropriate solution for each application. If they only consider price per gallon, but not the efficacy or reliability of the product, they could be literally pouring money down the drain.

The best approach is to look at the entire system the utility is trying to treat. Don't try to force a single product or solution. Look closely at how the system interacts and the different factors that need to be addressed. Choose the right program for the system and look at the total value and cost of program ownership.

The idea is to help the utility preserve infrastructure and help the community, too. Work with a vendor that offers multiple solutions and can help determine the best solution to address various situations.

What solutions can Evoqua provide to address corrosion?

Evoqua's responsibility is to be a trusted partner, providing expertise to find the best solution at the lowest cost of ownership. We have several interrelated products and suites of products around different chemistries. BIOXIDE® solutions treat multiple odor compounds and are basically non-hazardous. Our pH technologies reduce fats, oil, and grease (FOG) impact and can provide a beneficial alkaline supplement. Iron salt solutions aid in the removal of phosphorus and solids at the plant. Combining technologies can also address multiple conditions. The goal is to have more than one solution, a combination of products that solves problems for customers. Also helpful are smart controllers with the capability to adjust feed rates remotely, monitor flow, pH, and rain events. The controllers adjust feed rates to meet treatment goals, save money,and treat odor and corrosion more effectively. ■

To learn more: Schedule a system evaluation, where technical experts look at flows and system dynamics. We'll propose solutions to proactively treat hydrogen sulfide and extend the life of your collection system. Call Calvin Horst, Product Manager at 941-359-7969, email calvin.horst@evoqua.com or visit www.evoqua.com.