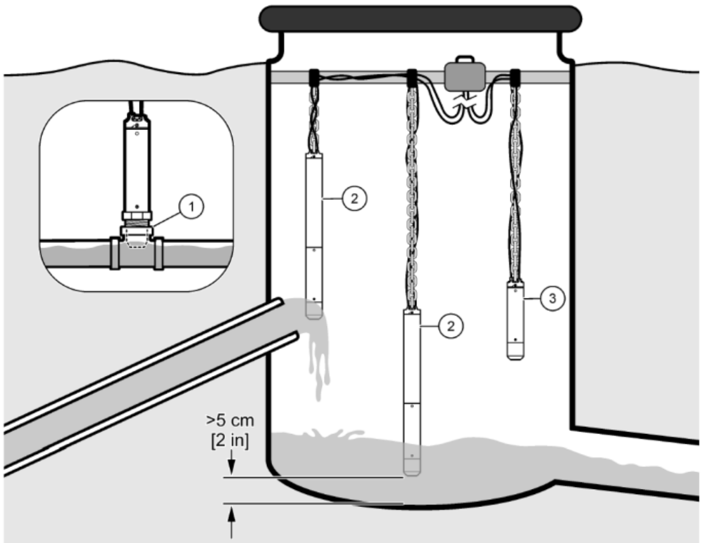
Why Measuring Hydrogen Sulfide In Wastewater Matters



1 In-pipe	3 Free-hanging in air
2 Free-hanging in liquid	

Summary

Hydrogen sulfide (H_2S) gas in wastewater environments is a familiar concern. But waiting until its odor is detected can be too late to exert as much control over it as desired. Fortunately, a new ability to monitor H_2S concentrations—in the liquid wastewater stream, in real time—is advantageous for wastewater professionals in terms of safety, cost, and consumer complaints. Here are four ways to capitalize on that capability.

Know How H_2S Behaves

- **How H_2S Forms.** The reaction of sulfates with anoxic biofilms in wastewater environments creates H_2S in the wastewater (Figure 1). As some of that H_2S turns into a gaseous form at the surface of the water, it can fill the headspace in pipes or other structures.
- **How H_2S Varies**. The severity of hydrogen-sulfide concerns can be exacerbated by conditions in the water and the surrounding environment. For example, long hydraulic-retention times in force mains, high turbulence, high temperatures, high acidity, and high biochemical oxygen demand (BOD) conditions can all magnify its concentration and impacts.
- **How H_2S Creates Problems.** The most common concerns about H_2S in wastewater applications are its potential impacts on worker safety, odor complaints, and corrosive effects on both metal and concrete infrastructure.

Multiple aspects of those attributes point to the importance of accurate hydrogen-sulfide detection and mitigation—for safety and financial reasons—and underscore the added value of measuring H_2S in the liquid phase as compared to the gas phase above it.

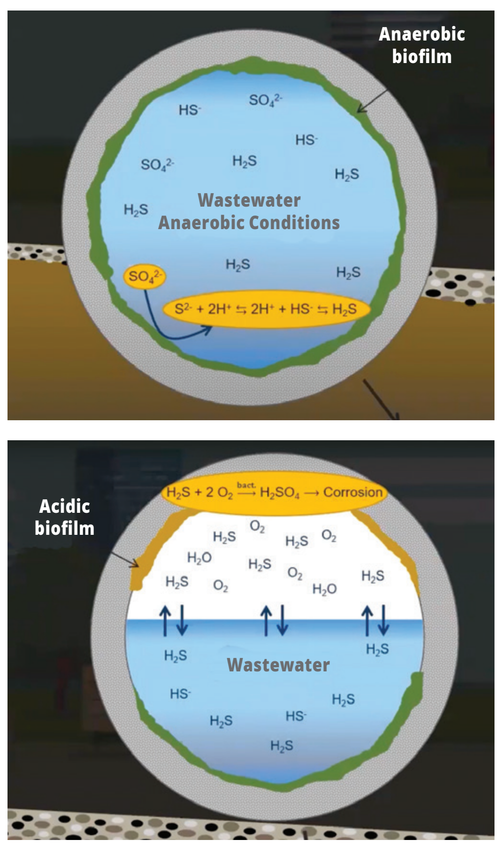


Figure 1. Hydrogen sulfide that forms in wastewater anaerobic films (top) transfers to the air in the headspace of wastewater infrastructure (bottom) where it can lead to workplace dangers, odor issues, and subsequent corrosion of exposed pipe and other infrastructure surfaces.

Understand Why It Matters

Even just a little bit of H_2S can lead to big problems. Its 'rotting egg' odor is noticeable at 0.5 parts per million (ppm) and corrosion also starts at 0.5 ppm. But the concentration measured near the top of a manhole can be vastly different than that measured in the wastewater itself (See Figure 2). Knowing the worst-case scenario by monitoring H_2S in the wastewater can have tremendous influences on the outcomes of hydrogen sulfide's three greatest challenges:

- **Worker Safety.** As bad as the typical hydrogen-sulfide odor complaints from the public are, news stories about accidental worker deaths in wastewater environments are worse. The better handle that utilities can get on actual hydrogen-sulfide concentrations in the wastewater earlier in the collection system or wastewater treatment plant (WWTP), the greater their awareness and ability to be effective in taking precautionary steps. Measuring the true hydrogen-sulfide content in the liquid provides the most realistic assessment of risk.
- **Odor Control.** There was a time when WWTPs and lift stations were situated far from population centers, but as open space in developed areas shrinks due to new construction, so too do the odds of odors going undetected by local residents. Accurately measuring hydrogen-sulfide concentrations at their worst in the liquid stream of collection-system feeder lines and at WWTP inlets gives wastewater utilities the opportunity to neutralize them before they cause a PR nightmare.
- **Corrosion Control.** Discovering damage through visible concrete deterioration—where H_2S converted into sulfuric acid by sewer-pipe biofilms eats away at the concrete surface, turns it into flakey gypsum, corrodes its reinforcing steel, and weakens the overall structure—is bad enough (Figure 3). Worse yet is undetected crown-rot corrosion in the headspace of an underground collection pipe that can lead to a collapse, damage to adjacent structures, and compounded remediation problems. Continuous monitoring of hydrogen-sulfide presence can provide an indication of potential deterioration and signal an increased need for periodic inspections.

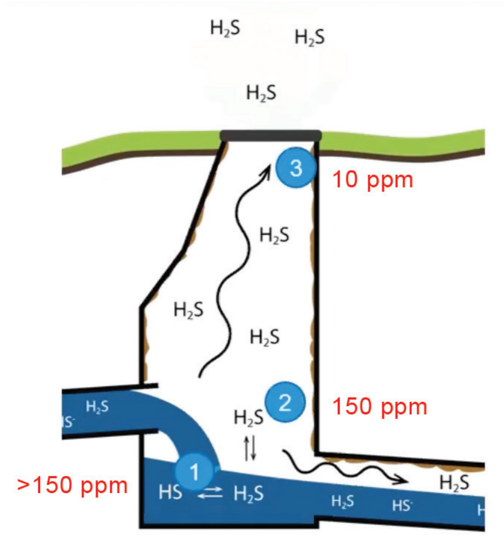


Figure 2. Where hydrogen-sulfide measurement takes place can have a major influence on the accuracy of the reading and the ability to manage the problem cost effectively. The highest concentrations and most consistently indicative readings are found in the wastewater itself (1). The air in the headspace just above the water (2) will typically give the next most concentrated reading, which can be 15x greater than the concentrations recorded at the top of a manhole (3).

Recognize The Advantages Of Liquid Measurement

While the sensitivity of the human nose makes it an early detection system for the presence of hydrogen sulfide gas, it is not a foolproof solution. In fact, high concentrations can quickly neutralize the nose's ability to smell this invisible gas and quickly incapacitate the individual exposed to it.

When it comes to detecting H_2S in a wastewater environment, assuming that liquid-phase and gas-phase detection are comparable can be misleading. Detecting H_2S in the liquid phase enables system operators to identify that compound at its highest concentrations—concentrations not necessarily exposed to the gas-phase sensing environment (Figure 2). Those more representative readings improve the ability to implement the most cost-effective options to neutralize H_2S. Sensors that provide accurate readings in both the liquid phase and the gas phase (Figure 4 see next page) provide maximum flexibility for monitoring or spot-checking multiple locations within a collection system or treatment plant to address safety, odor, or corrosion-protection concerns.

Figure 3. Sulfuric acid attacking the carbonates in cured concrete piping will compromise their capabilities as binding agents, turn solid pipe walls to flakey gypsum, and corrode the embedded reinforcing steel.

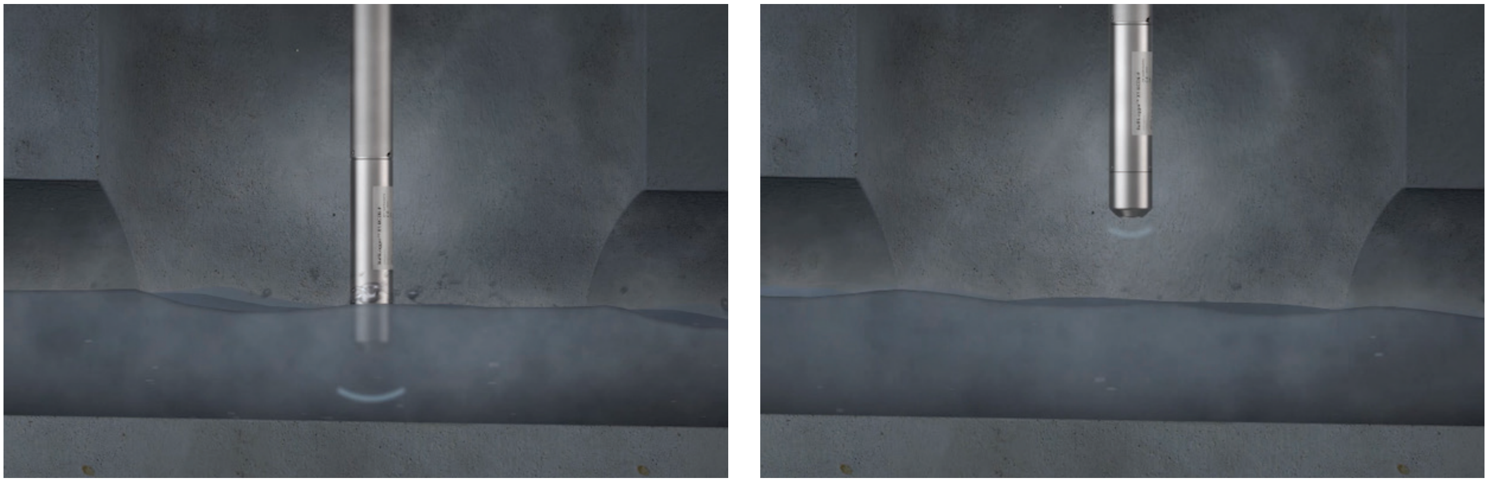


Figure 4. Having a portable sensor versatile enough to measure H_2S in the liquid phase (left) and the gas phase (right) gives wastewater professionals maximum flexibility to identify problem areas, pinpoint optimum continuous-monitoring locations, and optimize chemical treatments according to changing concentrations. Where it is practical, sensing in the liquid phase provides the most accurate measurement of the true hydrogen-sulfide presence in the wastewater.

Understand Where Liquid Measurement Saves Money

Being able to map locations where hydrogen sulfide is generated and collects is the first step to understanding the most efficient treatment reagent and dosing at the right location. While wastewater collection and treatment operators often have a sense of their traditional hydrogen-sulfide problem areas, the actual concentrations there can vary widely over time.

One particularly important location for measuring H_2S in the water instead of the air is in locations where multiple feeder lines come together. Monitoring the water from each flow can pinpoint the exact concentration in each liquid source instead of just a diluted average from all the flows in the headspace above the water. Being able to pinpoint specific areas for continuous monitoring gives operators the ability to track and treat the actual concentrations of H_2S accurately — even as those concentrations fluctuate. As the most accurate indicator of hydrogen-sulfide loading in any wastewater application, liquid-phase measurement can generate tremendous savings in chemical dosing additions and costs despite any fluctuations (Figure 5).

Having such an accurate picture improves the ability to manage odor, corrosion, or other problems with the minimal necessary investment in chemical treatment. That avoids the expense of overdosing and reduces the risk of upsetting delicate downstream biological processes. The same data can even be used to surcharge industrial customers whose sulfite or BOD-laden effluents contribute to costly problems or to convince them to implement pretreatment to reduce the impacts.

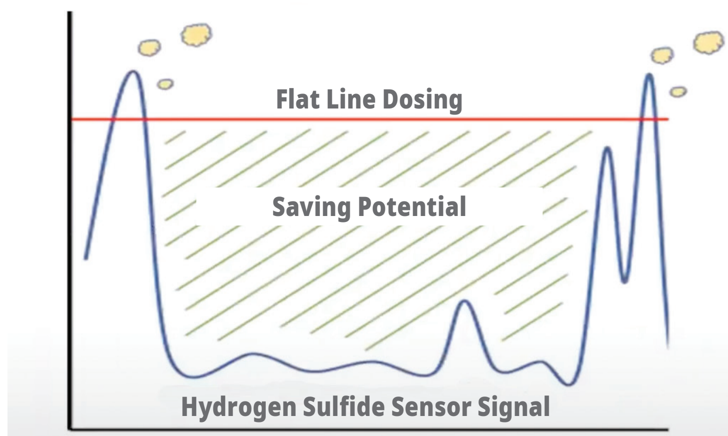


Figure 5. Providing chemical dosing in response to the actual level of H_2S in the water—as opposed to setting a high level of consistent dosing to accommodate peak hydrogen-sulfide values—offers tremendous savings potential. It also minimizes the potential impact of excessive chemical treatments having negative effects on downstream biological processes.

World Headquarters: Loveland, Colorado USA | hach.com

United States 800-227-4224 fax: 970-669-2932 email: orders@hach.com
Outside United States 970-669-3050 fax: 970-461-3939 email: int@hach.com

DOC043.53.30728.Jun22