Data-driven Chemical Dosing Optimization

Liquid-phase H_2S sensor cuts end-of-pipe chemical use by 50%

Problem

In order to prevent corrosion in the collection system and prevent public complaints caused by nuisance odors, water utilities utilize chemicals to mitigate H_2S—but they do so without optimizing their mitigation efforts.

Solution

By dynamically adjusting the chemical dosing rate to match real-time liquid-phase H_2S data from a Hach sensor, the effectiveness of $FeSO_4$ dosing at the end-of-pipe improved while chemical consumption dropped by 50%.

Benefits

- 50% reduction in chemical use.
- Zero H_2S downstream from the dosing point.
- Increased lifespan of assets (corrosion potential eliminated).
- No odor complaints.

Background

Hydrogen sulfide (H_2S) causes severe problems in collection systems when wastewater is pumped over long distances. To limit rotten-egg odors and to mitigate premature asset deterioration, utilities often add neutralization agents to the wastewater. However, without a dynamic overview of the H_2S concentrations in the wastewater, the optimal chemical dosing rate remains unknown. This lack of information implies that there will be either under dosing—or overdosing—and time-consuming dosing optimizations.

Challenge

A Danish water utility wanted to optimize the dosing of ferrous sulfates ($FeSO_4$) in a force main discharge well to reduce the consumption of chemicals and to improve the mitigation of potential H_2S related odor and corrosion issues in the collection system.

Solution

A small, self-contained dosing system was installed at the force main discharge well consisting of a Hach H_2S sensor, a dosing pump, and a chemical tank. In this setup, the Hach H_2S sensor's real-time H_2S signal was used as a dynamic control input for the dosing pump. By measuring directly in the raw wastewater at the end-of-pipe transition inside the well, the Hach H_2S sensor was able to quickly detect changes in the composition of the wastewater and thereby allow the fast-reacting chemicals to be added in just the right quantity. The dosing rate was simply proportional to the H_2S signal.

To measure the effect of the dosing setup, an additional Hach H_2S sensor was installed in the sewage in a manhole 1.2 km downstream in the gravity system, and using these two measurement points, different dosing strategies were implemented and compared.

The Hach H_2S sensor placed directly in the raw sewage in the inlet of the well.

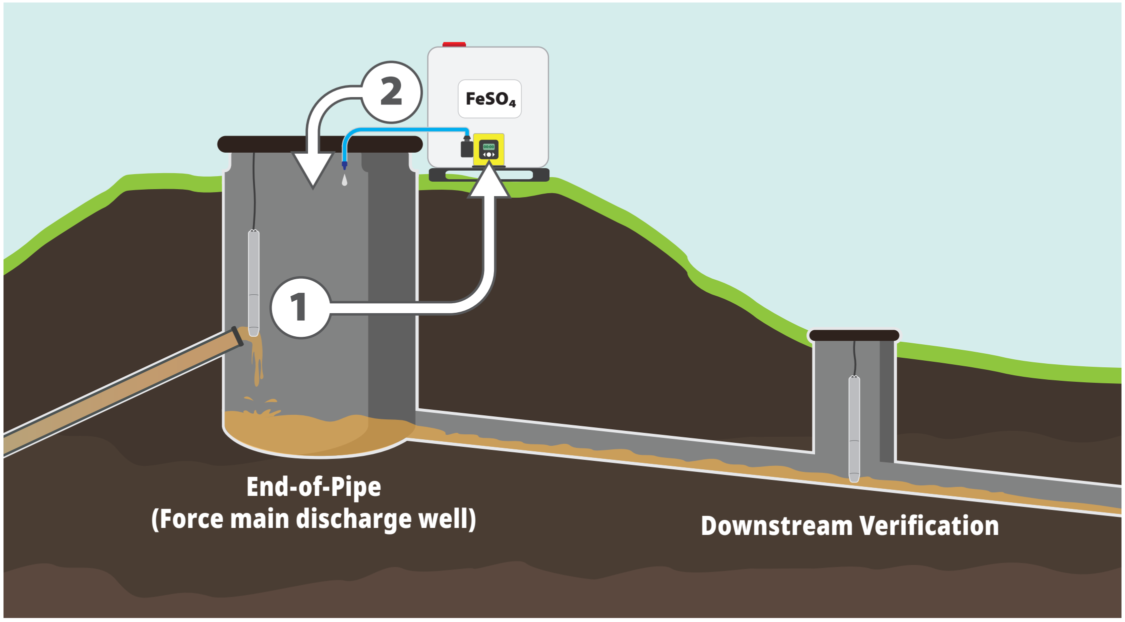
Results

With dynamic H_2S sensor-controlled dosing, the consumption of chemicals was optimized, and all downstream H_2S problems were fully mitigated.

With a constant dosing strategy, even using twice the daily amount of chemicals used for the sensor-controlled dosing strategy, the dosing was unable to fully neutralize the H_2S spikes above 1 mg/L.

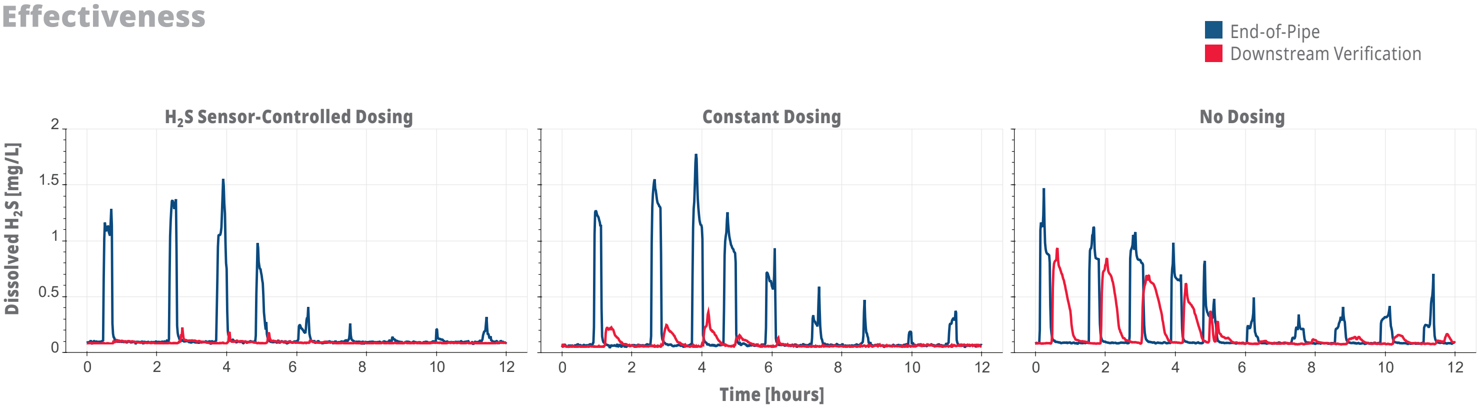
Without any dosing, the majority of the dissolved H_2S detected end-of-pipe was transported to the downstream verification site 20 minutes later, where odor and corrosion issues would persevere.

Dosing Setup

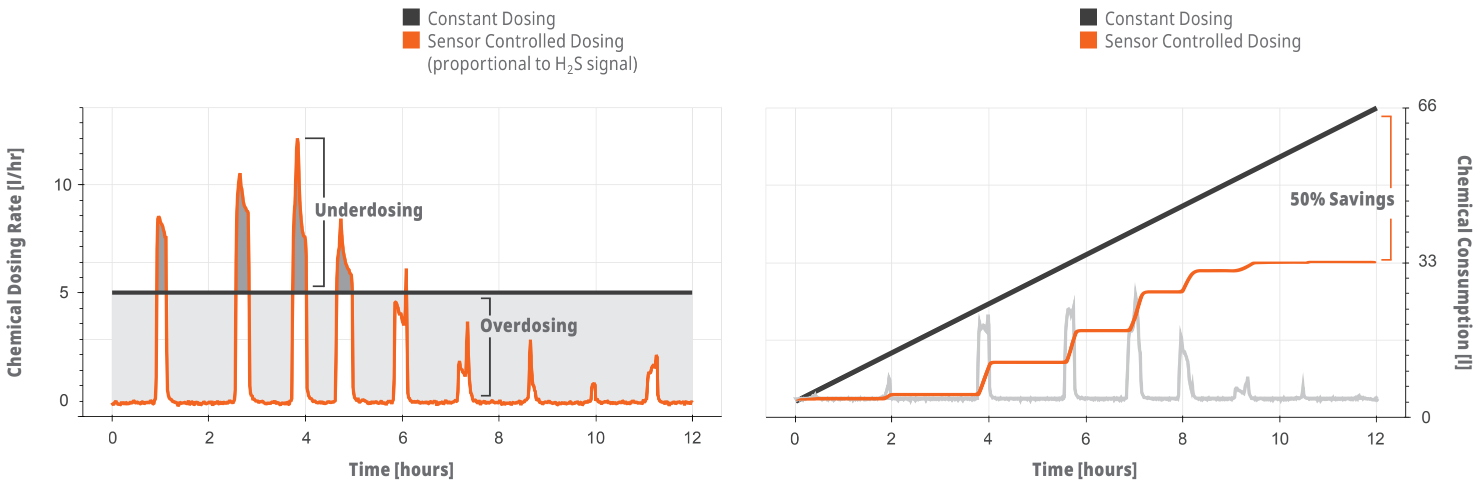


The Hach H_2S sensor delivered continuous H_2S data to a chemical dosing pump (1), which dynamically adjusted the dosing rate proportionally to the sensor signal (2). The effectiveness of the system was measured and compared to other approaches using a second Hach H_2S sensor measuring in the sewage 1.2 km further downstream.

Effectiveness



Chemical Consumption



The pitfalls of constant dosing

Constant chemical dosing—the dominant strategy used for the dosing of iron salts—is a simple but inefficient approach to H_2S mitigation. The fundamental shortcoming of this strategy is that H_2S is a dynamic variable—not a constant—and as the composition of the wastewater changes, a constant dosage is excessive throughout long periods of the day, yet also incapable of fully neutralizing the effect of H_2S spikes. The constant dosing strategy also fails to account for shifts in the magnitude of H_2S variations caused by factors including pump operation settings, changing seasons, varying temperatures, and heavy precipitation.

Savings potential

The H_2S sensor-controlled dosing strategy improved the effectiveness of the dosing system, thereby minimizing the impact of corrosion and odor issues, while using **50% less chemicals** compared to a constant dosing strategy. This case demostrates that a dynamic, sensor-controlled dosing strategy—using the Hach H_2S sensor—can enable utilities to optimize the effectiveness of H_2S management activities and reduce operational costs.

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