Data-driven Chemical Dosing Optimisation

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 odours, water utilities utilise chemicals to mitigate H_2S–but they do so without optimising 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 odour complaints.



Background

Hydrogen sulfide (H_2S) causes severe problems in collection systems when wastewater is pumped over long distances. To limit rotten-egg odours and to mitigate premature asset deterioration, utilities often add neutralisation 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 underdosing or overdosing and time-consuming dosing optimisations.

Challenge

A Danish water utility wanted to optimise 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 odour 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.

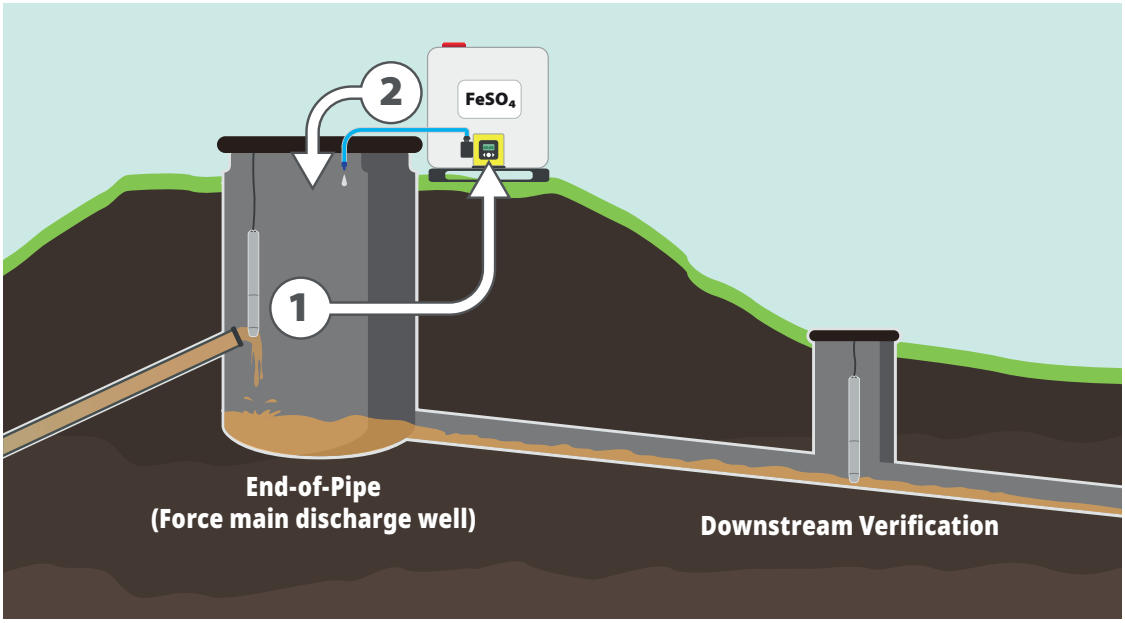
Results

With dynamic H_2S sensor-controlled dosing, the consumption of chemicals was optimised, 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 neutralise the H_2S spikes above 1 mg/L.

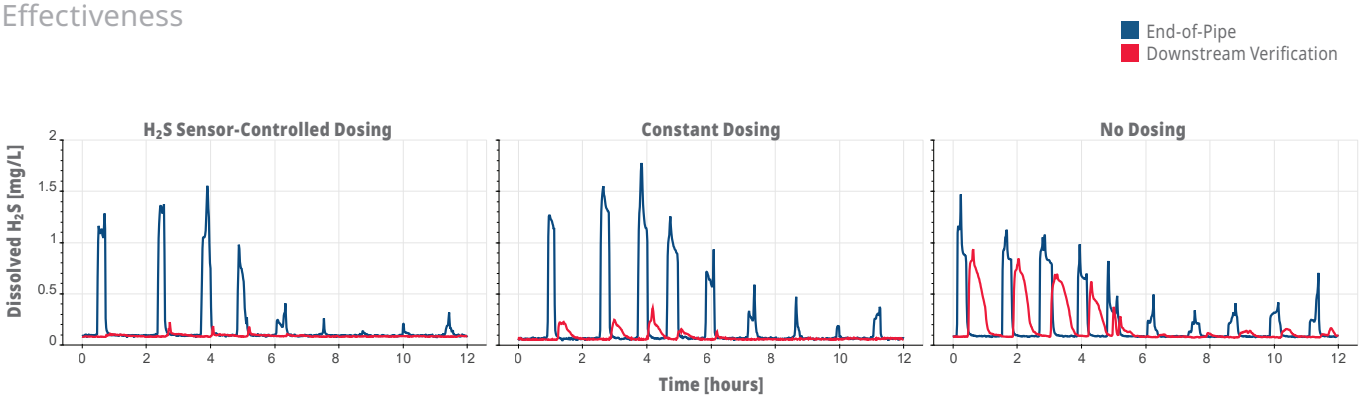
Without any dosing, the majority of the dissolved H_2S detected end-of-pipe was transported to the downstream verification site 20 minutes later, where odour and corrosion issues would persevere.

Dosing Setup

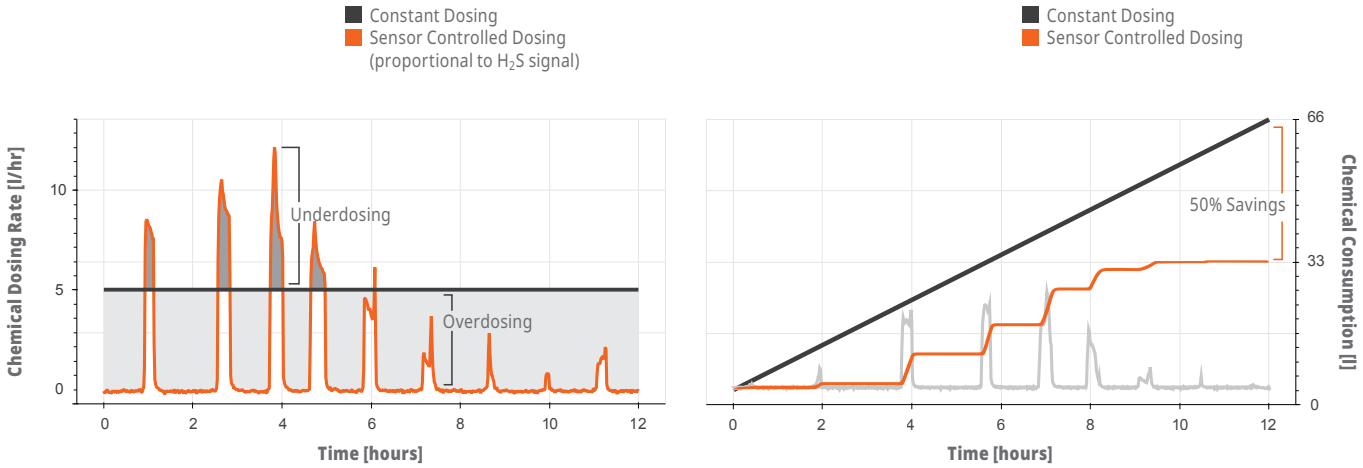


The Hach H_2S sensor delivered continuous H_2S data to a chemical dosing pump (1), which dynamically adjusted the dosing rate proportionally to the sensor signal (2). The effectiveness of the system was measured and compared to other approaches using a second Hach H_2S sensor measuring in the sewage 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 neutralising 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 minimising the impact of corrosion and odour issues, while using **50% less chemicals** compared to a constant dosing strategy. This case demonstrates that a dynamic, sensor-controlled dosing strategy, using the Hach H_2S sensor, can enable utilities to optimise the effectiveness of H_2S management activities and reduce operational costs.