Odour control and prevention of H_2S in a regional wastewater treatment plant

Presented at Ecomondo 2024 – The case study on the use of calcium nitrate for the prevention of H_2S and odours in wastewater was presented by Isabella Borella and Nicolas von Orelli for Acque e Chimici SA, in collaboration with Yara, on Tuesday, 5 November 2024, at Ecomondo in Rimini during the technical session 'Odour emissions: from mitigation methods to new control strategies'.

Technical focus: preventive control of hydrogen sulphide (H_2S), reduction of odour nuisance in sewer networks, protection against sulphuric acid corrosion, continuous monitoring and optimised dosing of nitrate-based Nutriox®.

The customer's challenge

A Swiss regional wastewater treatment plant, serving around 37,000 population equivalents and treating approximately 7 million m³ of municipal and industrial wastewater per year, was facing a critical odour problem in the sewer network.

The high concentrations of organic matter, combined with long retention times and anaerobic conditions, favoured the formation of hydrogen sulphide (H_2S), with significant consequences:

- strong odour nuisance in the surrounding area
- risk of infrastructure corrosion
- safety issues for operating personnel

The initial measurements showed a particularly critical and unstable situation, with peak values of up to 278 ppm H_2S and average values above 100 ppm.

Process context and operating conditions

The phenomenon was linked to the natural biological evolution of wastewater: gradual consumption of dissolved oxygen, lack of available nitrates and the resulting activation of sulphate-reducing bacteria.

As long as oxygen and nitrates are present, the degradation process produces odour-neutral compounds (CO_2, water, nitrogen). When oxygen is depleted, bacteria use sulphates, convert them into sulphides and part of the sulphides becomes H_2S gas.

In a warm and humid environment, H_2S is converted into sulphuric acid (H_2SO_4). This can damage concrete, steel, copper and silver.

The level of corrosion depends on the amount of H_2S and on the chosen prevention strategy.

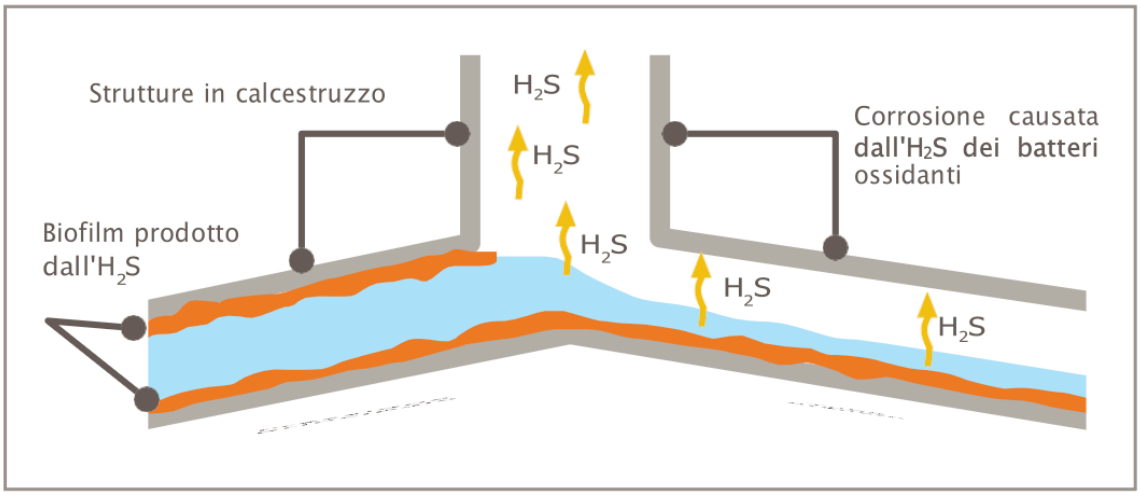


Fig. 1: Corrosion in a sewer system.

In addition to structural damage, H_2S also represents a serious risk to human health. It is a toxic gas that affects the nervous system and blocks cellular respiration; at high concentrations, it can be fatal even after a single inhalation. It is also flammable and explosive. H_2S is particularly dangerous because it is heavier than air, can accumulate in low-lying areas and may escape human perception, including by impairing the sense of smell.

soglia in ppm	Effetti sulla Salute
0.001 ppm	**Soglia dell'Odore:** Percezione odore di uova marce
3 - 7 ppm	Irritazione degli occhi, problemi respiratori.
5 ppm	Limite esposizione prolungata (EH40)
10 ppm	Limite esposizione limitata (EH40)
10 - 50 ppm	Mal di testa, fatica, diarrea, perdita di concentrazione, capacità polmonare ridotta, irritazione degli occhi.
50 - 100 ppm	Danni cronici al cervello e all'apparato respiratorio, danni agli occhi.
100 - 300 ppm	Perdita dell'olfatto. Un'esposizione prolungata può portare alla morte anche dopo alcune settimane come conseguenza della polmonite da aspirazione.
300 - 500 ppm	Morte dopo 6-24h causata da edema polmonare (colpisce il sistema nervoso)
500 - 1000 ppm	Morte immediata

Fig. 2: Health risks of H_2S.

Under certain conditions, the process can become critical, especially in the presence of:

- high organic loads (COD/BOD)
- favourable temperatures
- long retention times in the sewer network

The behaviour of the system was highly variable and difficult to control, making effective control with traditional approaches more challenging.

Our approach

The measure was based on a preventive strategy through the controlled dosing of a calcium-nitrate-based solution, in order to promote denitrifying bacteria and inhibit the formation of H_2S.

The approach was structured in three phases:

1. Initial monitoring

Installation of probes for continuous measurement of H_2S at the critical points of the network.

2. Test phase

Start of dosing in the inlet tank (~1,572 m³) with gradual adjustment:

- 3–4 l/h → H_2S reduction of ~50%
- 6–8 l/h → H_2S reduction of ~80%

3. Dosing optimisation

Definition of the optimal dose through correlation with:

- flow rate
- temperature
- COD
- H_2S concentration

In this way, an effective setpoint of around 3–3.5 l/h was identified, with continuous control and remote monitoring.

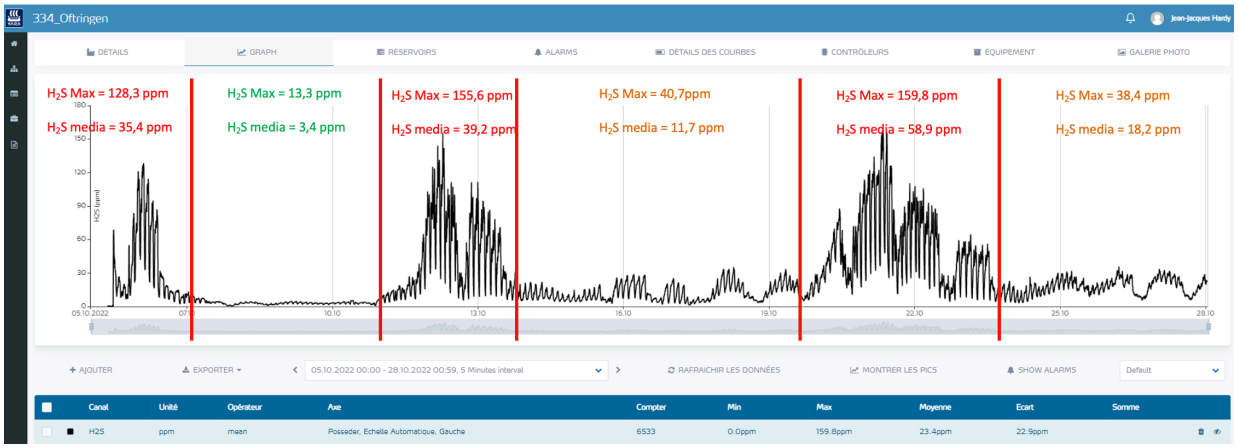


Fig. 3: H_2S concentration before the start of dosing. High and very irregular concentrations!

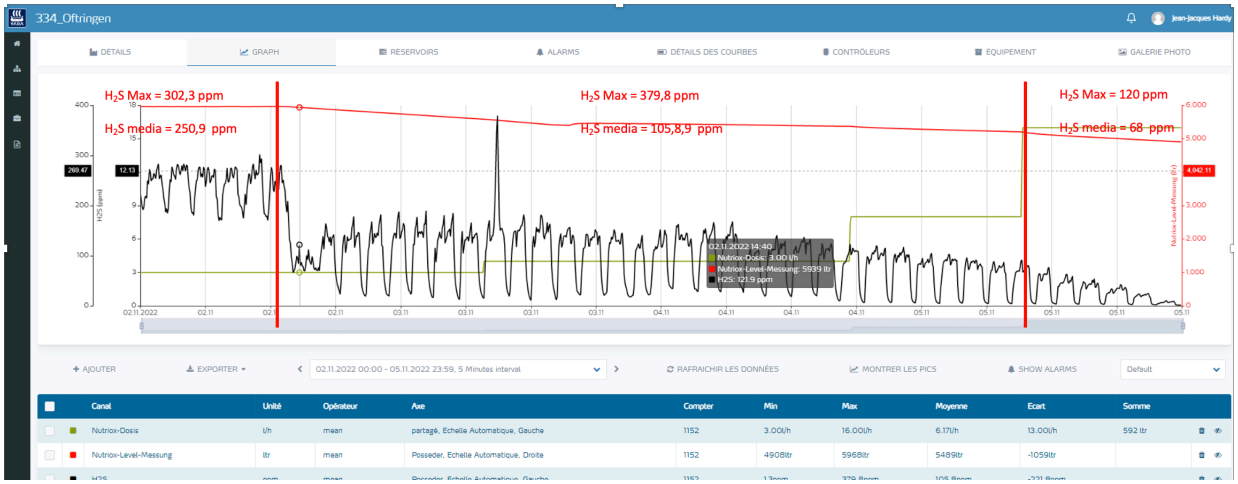


Fig. 4: Gradual reduction of H_2S during the test with different dosing rates.

The product in detail – Nutriox by Yara

Nutriox is a product based on nitrate salts and acts as a preventive biological solution. Its effect is based on maintaining a favourable bacterial balance, thereby preventing the activity of sulphate-reducing microorganisms and blocking the formation of H_2S at the source.

The properties of Nutriox:

- 100% biodegradable and pH-neutral
- Continuous action
- Does not damage infrastructure
- Reduces corrosion and extends the service life of the installations
- Improves wastewater treatment: lower oxygen consumption and therefore energy savings

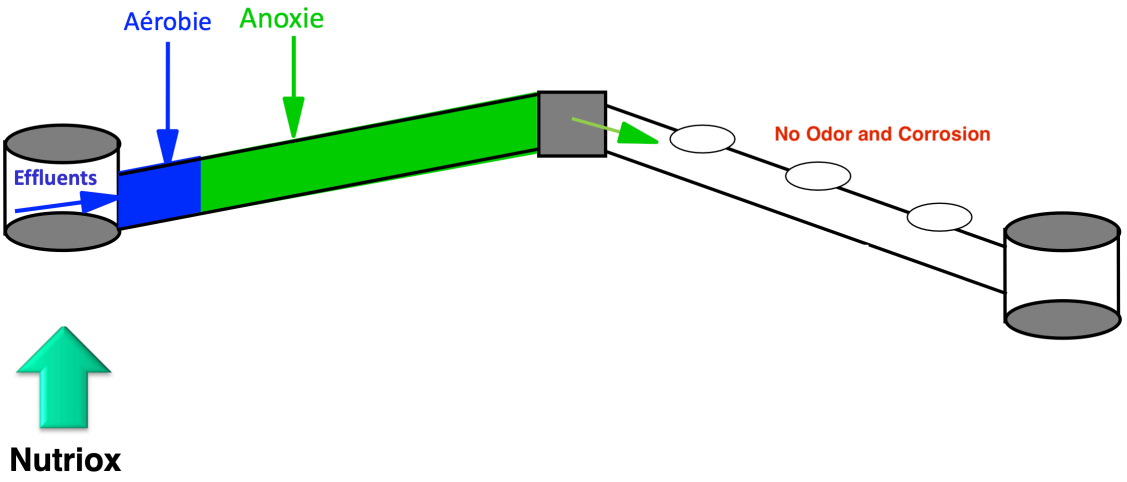


Fig. 5: Mode of action of Nutriox by Yara.

Results in brief

During the tests, an H_2S reduction of up to 80% was observed, followed by stabilisation of the average values at around 5 ppm. Peak events were also eliminated, resulting in more stable and efficient control of the system. The process was managed through continuous and automated monitoring, which enabled optimisation of plant performance. The results achieved ultimately led to the installation of a permanent system after completion of the test phase.

Why the customer benefited

The measure led to concrete and measurable benefits:

Environmental improvement

- elimination of disturbing odours
- higher acceptance of the plant in the surrounding area

Protection of asset value

- reduction of the risk of corrosion caused by sulphuric acid
- extension of the service life of the infrastructure

Operational safety

- significant reduction in exposure to toxic gases

Operational efficiency

- automated and remotely monitorable system
- optimised dosing → lower product losses

Conclusions and key message

The use of a preventive strategy based on a nitrate solution from Yara proved to be very effective for controlling H_2S, even under variable and complex operating conditions.

The case shows that an integrated approach — intelligent monitoring and intelligent dosing — not only solves the odour problem, but also optimises plant operation and protects the infrastructure over the long term.

Information for online publication

Suggested SEO title: Calcium nitrate for the prevention of H_2S and odours in wastewater | Acque e Chimici SA case study

Suggested meta description: Case study on Nutriox® by Yara and calcium nitrate for the prevention of H_2S in wastewater: reduction of hydrogen sulphide by up to 80%, odour control, corrosion protection and continuous monitoring in a Swiss regional wastewater treatment plant.

Authoritative context: The content is based on a technical experience presented at Ecomondo 2024 by Isabella Borella and Nicolas von Orelli of Acque e Chimici SA, in collaboration with Yara, during the session on odour emissions and control strategies.

Important keywords: calcium nitrate, Nutriox, Yara, H_2S, hydrogen sulphide, odours in wastewater, odour treatment in wastewater treatment plants, sewer network corrosion, sulphuric acid, H_2S monitoring, nitrate dosing, wastewater odour control.

Questions answered by this document: How is H_2S formed in sewer networks? How can odours in wastewater be prevented? How does calcium nitrate work in the biological control of H_2S? What are the benefits of dosing Nutriox® in a wastewater treatment plant?