HACH
Be Right™

Enhancing nitrogen treatment in municipal wastewater

Lab and process solutions for reliable nitrogen monitoring and control





Background

Municipal wastewater treatment plants (WWTPs) across Europe are under growing pressure to improve nitrogen removal performance. The revised Urban Wastewater Treatment Directive (UWWTD), published in December 2024, introduces stricter discharge limits for total nitrogen (TN). These limits reflect increasing concerns over eutrophication, groundwater contamination, and broader environmental impacts.

In municipal wastewater, nitrogen enters the plant primarily in two forms: ammonium (NH_4^+) and organic nitrogen. These compounds originate from human waste and domestic sources and are typically the dominant nitrogen species in the influent. During biological treatment, these forms are transformed into oxidised species – mainly nitrate (NO_3^-), and occasionally nitrite (NO_2^-) – through microbial processes.

The removal of nitrogen relies on two key biological steps: nitrification, where ammonium is oxidised to nitrate under aerobic conditions and denitrification, where nitrate is reduced to nitrogen gas under anoxic conditions.

These processes are sensitive to environmental conditions such as oxygen levels, pH, temperature, and carbon availability. Maintaining stable and efficient nitrogen removal requires careful monitoring and control throughout the treatment chain. Since regulatory limits are expressed in total nitrogen, operators must ensure that all forms (ammonium, nitrite, nitrate, and organic nitrogen) are effectively managed.

Solutions Overview

Nitrogen monitoring in municipal wastewater treatment relies on a combination of laboratory and online process solutions, each serving distinct but complementary roles. Laboratory analysis is essential for regulatory self-monitoring, particularly at the inlet and outlet of the plant. It enables operators to demonstrate compliance with discharge permits and sampling frequencies defined by the Urban Wastewater Treatment Directive. Composite sampling and standardised cuvette tests provide reliable, traceable data for reporting. Beyond compliance, lab measurements can also support process optimisation, helping validate online data and guide operational decisions.

Online sensors provide continuous insight into nitrogen dynamics throughout the plant. At the inlet, they help anticipate load variations and protect biological processes from shock loads. Within the process, they support the control of nitrification and denitrification. Real-time data enables operators to adjust aeration, sludge wasting, and carbon dosing to maintain stable biological performance. At the effluent, online monitoring ensures discharge limits are consistently met, providing confidence and operational peace of mind.



Solutions for reliable nitrogen monitoring and control

Laboratory solutions for nitrogen

Laboratory solutions from Hach® combine precision, safety, and sustainability. Spectrophotometers paired with LCK cuvette tests for nitrogen compounds (NH_4^+, NO_2^-, NO_3^-, TN) deliver traceable and compliant results with minimal operator handling. Barcode recognition and pre-dosed reagents reduce human error and ensure consistent performance.

To support safe operations, all reagents are sealed and colour-coded, minimising exposure and simplifying waste handling. Used cuvettes can be returned via Hach's Recycling Centre program, which ensures proper disposal and contributes to circular resource management. This not only reduces environmental impact but also supports plant sustainability goals.



AN-ISE sc – Online ammonium & nitrate sensor

The AN-ISE sc sensor combines ammonium and nitrate measurement in a single probe using ion-selective electrode (ISE) technology, with no reagents or sample preparation required. It automatically compensates for potassium and chloride interferences. The consumable cartridge lasts up to one year. The sensor serves as a reliable trending tool for process monitoring.



NT3100sc – Online nitrate sensor

The NT3100sc provides continuous, reagent-free nitrate measurement using UV absorption. It features automatic turbidity compensation, ensuring accurate readings even in variable influent conditions. With detection limits down to 0.02 mg/L NO_3-N, it supports precise control of nitrification, denitrification and effluent compliance. Maintenance is minimal thanks to the automatic wiper system.



NH6000sc – Online ammonium analyser

The NH6000sc sets a new standard for ammonium monitoring in wastewater treatment. Powered by Gas Sensing Electrode (GSE) technology, it is the only technology capable of delivering reliable measurements every 5 minutes, enabling tight process control and rapid response to load variations. It features automatic calibration, cleaning, and validation, minimising manual intervention and ensuring consistent data quality. Its modular design now features a redesigned sample filter that improves air-cleaning and adds a chemical cleaning function. Integrated sample delivery pumps ensure flexible installation and robust performance even in harsh environments. Whether used within the biological process, or at the effluent, the NH6000sc delivers fast, accurate, and low-maintenance ammonium monitoring, helping plants stay compliant and optimise performance with confidence.



EZ-TN, EZ-Alkalinity & EZ-Nitrite: Targeted analysers for specific needs

While most plants rely on standard sensors for routine nitrogen monitoring, certain situations call for more advanced instrumentation. The EZ series analysers (EZ-TN, EZ-Alkalinity, and EZ-Nitrite) are designed to meet these specialized needs.

- EZ-TN provides high-precision total nitrogen measurement at the discharge point, supporting regulatory compliance with the revised UWWTD.
- EZ-Alkalinity and EZ-Nitrite, on the other hand, are process-focused tools. They help operators maintain biological stability by tracking key indicators that influence nitrification and denitrification performance.

All three analysers offer compact, automated operation with titration or colorimetric methods, automatic calibration and cleaning, and multistream capabilities.





From monitoring to active control

Having online measurement is great – but it's even more valuable when it drives real-time process optimisation. By coupling sensors with advanced control strategies, plants can turn data into action. Hach's RTC (Real-Time Control) technology combines robust instrumentation, proven algorithms, and dedicated software to optimise nitrification and denitrification, adjusting aeration, recirculation, or carbon dosing based on actual process conditions.

Benefits and perspectives

With over 90 years of analytical expertise and the Dr. Lange legacy, Hach delivers a complete ecosystem for nitrogen treatment: premium laboratory instruments, robust online sensors, advanced control software, and easy-integration shelter solutions. Our predictive diagnostics and real-time control systems enable 24/7 automated process optimisation, helping plants ensure compliance with evolving nitrogen discharge limits, stabilise biological performance under variable loads, and reduce energy consumption linked to aeration. By leveraging intelligent algorithms, operators can minimise chemical overdosing for carbon sources and detect performance drift early, turning monitoring into actionable control.

Backed by the industry's largest local service team and global expertise, we maximise up-time and ensure the highest measurement availability on the market. Hach is your trusted partner for reliable, efficient, and future-ready nitrogen management.

