DESIGN PERSPECTIVE

# How Continuous Monochloramine Monitoring Provides Early Warning Of Nitrification

*By the time a total chlorine grab sample confirms a residual has dropped, the biological process behind it has usually been running for weeks. Measuring monochloramine directly moves that warning forward.*

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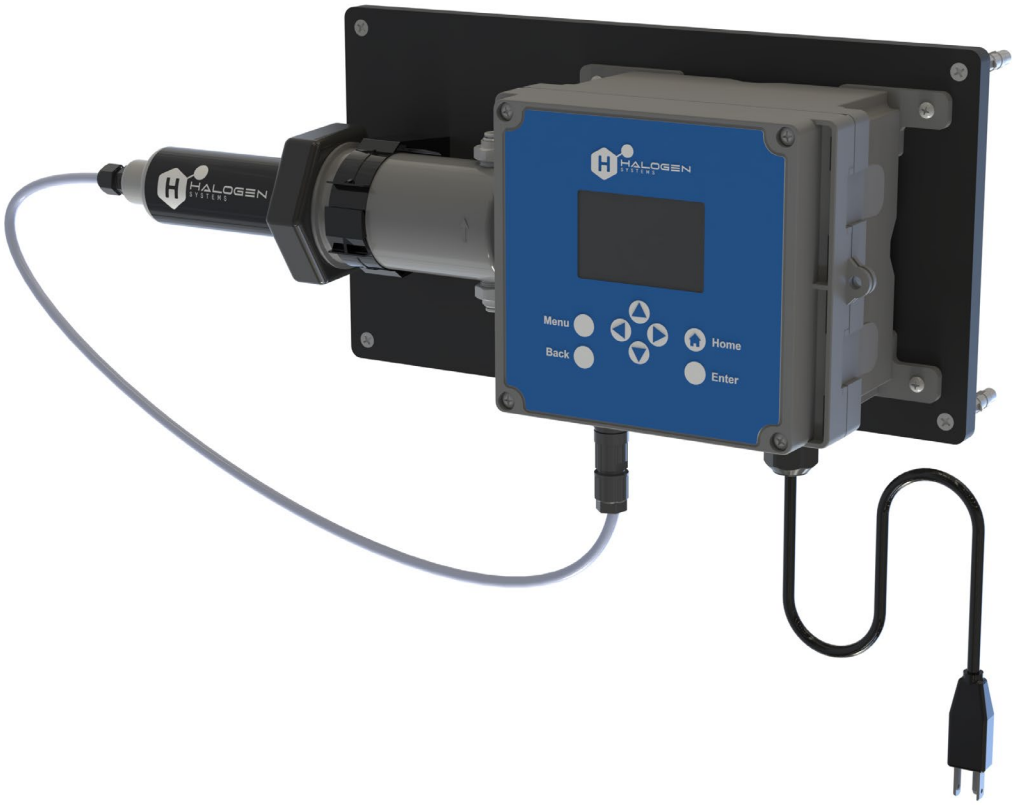


*The Halogen Systems MP-Total measures free chlorine, total chlorine, and monochloramine on a single in-pipe sensor, paired with the D20™ controller — no membranes, no reagents, no sample-to-drain waste stream.*

Nitrification is the quiet failure mode of chloraminated distribution systems. It rarely announces itself. It builds in a warm storage tank or a low-flow dead end, consumes the residual from the inside, and only becomes visible on a routine sample once the disinfection margin is already gone. The parameter that would have warned you earlier is not total chlorine. It is monochloramine itself.

## What is nitrification, and why does it threaten chloraminated systems?

**Nitrification is the microbial oxidation of ammonia to nitrite and then nitrate, and in a chloraminated system it accelerates the loss of the monochloramine residual you rely on for secondary disinfection.** Chloramination always leaves some free ammonia in the water — dosed as a

small excess, or released as monochloramine naturally decays. That ammonia is food for ammonia-oxidizing bacteria and archaea. As they multiply, they produce nitrite, which exerts its own chlorine demand and drives monochloramine down further, freeing still more ammonia. The result is a self-reinforcing loop that is hardest to break in exactly the conditions most systems face in summer: warm water, long detention times, storage tanks, and system extremities.

## Why does a total chlorine reading miss the early signs?

**Total chlorine tells you how much combined residual remains, but not which species make it up or why it is changing — so it trails the chemistry that actually predicts a nitrification event.** A total chlorine value lumps monochloramine together with dichloramine and organic chloramines. In the onset phase of nitrification, monochloramine begins converting and declining while free ammonia and nitrite climb — changes that are underway well before total chlorine crosses an action limit. Grab samples compound the lag: nitrification is episodic and localized, so a weekly snapshot at a fixed tap can easily miss the tank or dead end where the episode is incubating.

> ***"Nitrification builds from the inside. The residual you can measure is the last thing to fall, not the first."***

## What early indicators does continuous monochloramine data reveal?

**A continuous monochloramine signal exposes the leading indicators — a declining monochloramine-to-total-chlorine relationship, a rising residual decay rate, and shifting free ammonia — days before a single grab sample would trip an alarm.** The value is in the trend, not the instantaneous number. A site that normally holds a stable monochloramine residual overnight and begins to show a steeper nightly decline is telling you something a spot reading cannot. Because the sensor establishes a site-specific baseline, operators can watch rate-of-change rather than waiting for an absolute threshold, and act while there is still residual left to protect.

## Where should monochloramine be monitored?

**The highest-value monitoring points are the places where nitrification starts — storage tank inlets and outlets, system extremities, low-flow zones, and rechlorination or booster stations.** These are also the sites where conventional analyzers are hardest to justify, because a bypass-style instrument needs a continuous sample-to-drain flow and a place to send it. An in-pipe measurement removes that constraint: the sensor reads the process water directly, with no flow cell, no waste stream, and no sewer lateral to permit at a remote tank or vault.

## How does in-pipe measurement change the operational response?

**Continuous in-pipe data turns nitrification management from a reactive flushing exercise into a scheduled, defensible response.** Instead of reacting to a failed sample, operators can trigger targeted flushing, adjust the chlorine-to-ammonia ratio, or bring a booster online at the first sign of a decay trend — flushing the zone that needs it rather than the whole district, and documenting the intervention for the regulator. Less water is lost, the residual is defended earlier, and the response is backed by a continuous record rather than a single reading.

## How does the monitoring approach compare?

The practical differences between periodic grab sampling and continuous in-pipe monochloramine measurement fall into a few categories:

| | Grab sample + DPD | Continuous in-pipe monochloramine |
|---|---|---|
| **Detection timing** | After the fact — a snapshot | Leading trend, days earlier |
| **Speciation** | Total combined only | Monochloramine resolved directly |
| **Coverage** | One tap, one moment | Continuous at the at-risk site |
| **Waste stream** | None at tap; reagents used | None — no sample-to-drain |
| **Operator burden** | Manual, skill-dependent | Automated, trend-based alarms |

## Measuring monochloramine directly, in the pipe

Halogen Systems designed the MP-Total to measure monochloramine as a distinct value alongside free and total chlorine, pH, ORP, conductivity, and temperature — on a single in-pipe probe. The bare-electrode amperometric design uses no membranes and no reagents, resolves down to 1 ppb, and holds a six-month calibration interval, while the SensiCLĒNE™ self-cleaning system keeps the electrode stable in the low-flow, biologically active conditions where nitrification takes hold.

For specifications, installation configurations, and application notes on continuous in-pipe monochloramine monitoring, visit halogensys.com.

## Frequently asked questions

**What causes nitrification in chloraminated water systems?** Excess free ammonia — either dosed or released as monochloramine decays — feeds ammonia-oxidizing microorganisms, which produce nitrite and accelerate residual loss, especially in warm water with long detention times.

**Can you detect nitrification with total chlorine alone?** Not early. Total chlorine only confirms the residual has already fallen; the monochloramine decline and rising free ammonia that precede it are the more useful warning signals.

**What monochloramine level indicates a healthy residual?** It is system-specific, but a stable monochloramine value holding at or near the target residual — without a rising nightly decay rate — is the practical marker; the trend matters more than any single number.

**Where should I monitor first?** Start at storage tanks, system extremities, and low-flow zones — the locations where warm, slow-moving water lets nitrification establish before it reaches monitored taps.

**Does continuous monitoring replace regulatory grab sampling?** No. It complements compliance sampling by providing the early, continuous trend data that lets you act before a compliance sample is at risk.