



The Benefits of Advanced Biological Denitrification for Nitrate Contamination in Drinking Water

Nitrate contamination is a pressing challenge for drinking water systems across the U.S. An April 2026 report from the Environmental Working Group found that about one-fifth of the U.S. population drinks water with nitrate concentrations exceeding recommended health guidelines. The U.S. EPA has established a maximum contaminant level of 10 mg/L for nitrate, a threshold that many groundwater systems struggle to meet.

Although nitrates are naturally occurring compounds found in soil, water, and air, elevated concentrations in drinking water sources are largely driven by human activity, especially agricultural practices. Fertilizers, livestock manure, and runoff transport nitrogen compounds into groundwater, rivers, and reservoirs. The presence of nitrates in drinking water has been linked to a range of health concerns, including cancer in adults and adverse effects on infant health (e.g., blue baby syndrome).

To address nitrate contamination, water utilities have traditionally relied on treatment technologies including reverse osmosis (RO) and ion exchange (IX). While these solutions are effective at removing nitrates, they present significant operational and environmental challenges, including high energy demand, system complexity, and the generation of concentrated brine requiring management and safe disposal.

Both RO and IX generate concentrated waste streams containing high levels of nitrates and other contaminants that must be managed, treated, or disposed of. This creates several issues, including increased operational costs, additional infrastructure requirements, and environmental concerns related to disposal. In many cases, these systems do not eliminate the problem entirely — they simply transfer it to another stage of the process.

So, how can nitrates be removed without creating new problems? An alternative approach is biological denitrification.

Biological denitrification is an efficient and safe method for denitrifying drinking water, addressing nitrate contamination and the waste-management challenges associated with RO or IX nitrate-removal systems. Instead of separating nitrate from water, as RO and IX do, biological denitrification replicates natural environmental processes to safely transform nitrate to nitrogen gas, avoiding the production of hazardous waste and minimizing environmental impact.

The BIOBOX® Nitrate system, manufactured by BIOBOX Water from Zaragoza, Spain, and represented by AMS in the U.S., is a proprietary biological denitrification system delivered in either a containerized or full-scale system configuration for drinking water applications. BIOBOX Nitrate is designed to achieve over 95% nitrate removal while maintaining low water consumption (3-5%) and producing minimal waste using NSF 60/61 Standard approved biomaterial (certified Food Grade, Group 1). Key performance indicators include:

- Treated water Total Organic Carbon (TOC) below 2 ppm
- Turbidity under 0.3 NTU



BIOBOX Nitrate uses a proprietary process to ensure an anoxic environment, ideal for the growth of denitrifying bacteria, guaranteeing the management of biological activity and maintaining a stable biofilm. Thanks to this optimized design, nitrate reduction to nitrogen gas happens in a single step with minimized contact time — even at high nitrate concentrations.

The technology also features online remote condition monitoring, providing real-time health data for the onboard water-quality instruments. BIOBOX Nitrate is the only biological denitrification technology that combines fully automated control with continuous monitoring. This unique approach allows for remote process control and optimization. It is also key to how BIOBOX replicates the natural process, but in an automated and intensified way.

As nitrate contamination persists across many regions in the U.S., especially agriculturally intensive areas, utilities are increasingly evaluating treatment approaches that meet regulatory limits and reduce long-term operation and environmental burdens.

Traditional technologies like RO and IX remain effective but their reliance on concentrate disposal presents ongoing challenges. BIOBOX Nitrate offers a space-saving, energy-efficient, and sustainable biological denitrification treatment option for water utilities seeking to avoid the cost and complexity of brine management. For communities with rising nitrate levels and limited disposal options, biological treatment and BIOBOX Nitrate offer a practical, sustainable alternative for nitrate management.