

Breaking the Upset Cycle: NANOBUBBLE TECHNOLOGY DELIVERS FIRST STABLE SEASON IN YEARS

Client: Henry N. Wochholz Regional Water Recycling Facility, Yucaipa, CA (WRWRF)

Treatment Plant Metrics:

- Influent flow: 3.8 MGD (17,275 m³/d)
- BNR Process

Key Challenges:

- Recurring seasonal process upsets (minimum 2x annually)
- Biomass die-off, loss of nitrification, poor settleability
- High turbidity and MF system fouling
- Intensive operator intervention requirements

Performance Results:

- **System-Wide:** 10%▲ net ammonia removal, 24%▼ blower energy/lb ammonia removed
- **Operations:** Zero seasonal upsets during demonstration (first time in years)

Challenge:

Chronic Process Instability

The WRWRF experienced seasonal upsets that disrupted biological nutrient removal (BNR), compromised effluent quality, and required emergency interventions. These events caused biomass die-off, nitrification loss, poor sludge settling, elevated turbidity, and membrane fouling, creating operational headaches and regulatory compliance risks.

Historically, management relied on reactive approaches: increased chemical dosing, extended aeration, and frequent membrane cleaning. These costly interventions diverted resources from optimization activities while not able to prevent future upsets.

Solution:

Nanobubble Pretreatment Technology, NanoShield

Nanobubbles (< 200 nm) are ultra-fine gas bubbles that remain suspended in liquids. Their unique properties enable multiple treatment enhancement mechanisms:

- ✓ **Electrochemical Activity:** Attracts and destabilizes hydrophobic inhibitory compounds
- ✓ **High Interfacial Area:** Improves microbial-substrate interactions through Brownian motion
- ✓ **Biocatalytic Enhancement:** Accelerates enzymatic reactions, converting slowly biodegradable COD to readily biodegradable forms

Strategic upstream placement ensures the benefits of nanobubbles cascade throughout the treatment train, providing system-wide process intensification rather than localized improvements.

Results:

Transformative Performance Gains with NanoShield

✓ Primary Treatment Enhancement

Nanobubble pretreatment improved primary clarifier performance by preventing sludge septicity, even under increased loading. This enhancement produced higher-quality primary sludge, with TSS removal increased 16% (from 50% to 66%) while COD removal improved 11% (from 47% to 58%). Primary effluent quality enhanced significantly with 16% COD reduction and 13% ammonia reduction, even with 7% higher influent ammonia loading.

✓ Secondary Treatment Stabilization

Biological processes showed marked stability improvements. SVI improved 40% (from 119 to 114 mL/g) while MLSS increased 29% (from 3,462 to 4,479 mg/L), indicating stronger biomass development. Secondary effluent quality also significantly improved, with 67% ammonia reduction (from 0.18 to 0.06 mg/L), 25% COD reduction (from 31.7 to 23.9 mg/L), and 6% nitrate reduction (from 5.0 to 4.7 mg/L).



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✓ System-Wide Optimization

Net ammonia removal increased 10% (from 1,096 to 1,204 lbs/day-N) while energy efficiency improved substantially—**blower energy per pound ammonia removed decreased 24%** (from 3.3 to 2.5 kWh/lb-N), representing a **20% gain in BNR capacity**. Most significantly, zero seasonal upsets occurred during the demonstration period.

✓ Operational Benefits

Reduced O&M Costs:

- Eliminated upset-related chemical dosing and emergency interventions
- Reduced membrane cleaning frequency and equipment maintenance
- Decreased labor requirements for reactive troubleshooting

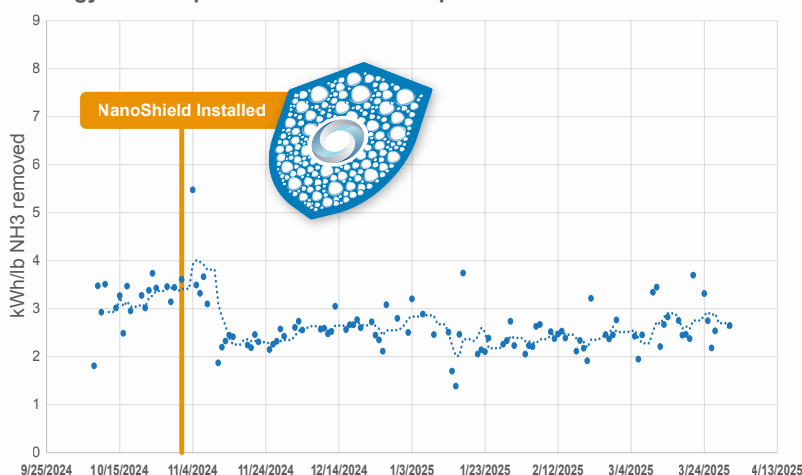
Enhanced Reliability:

- Consistent Title 22 reuse compliance
- Improved process predictability and planning capability
- Reduced regulatory risk and operational uncertainty

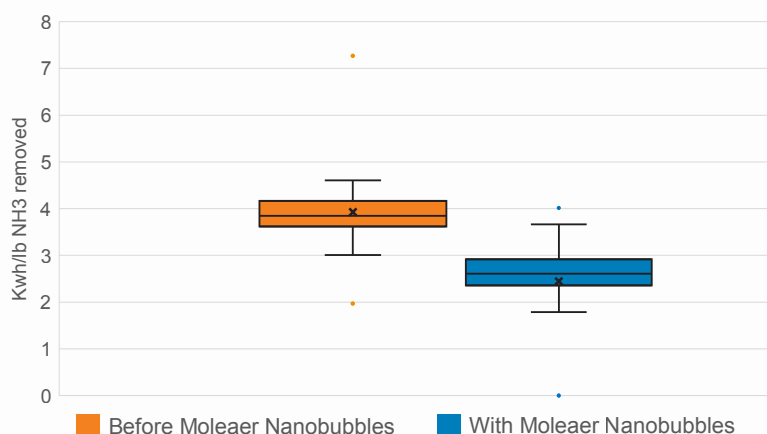
Future Implications

The Yucaipa success demonstrates nanobubble technology as a paradigm shift from reactive upset management to proactive process stabilization. As water reuse regulations tighten and treatment requirements intensify, Moleaer NanoShield represents a cornerstone technology for next-generation water recycling facilities. The technology's proven ability to deliver reliable performance improvements while reducing operational complexity positions it as an essential component for utilities seeking enhanced treatment reliability and sustainable operations.

Energy Consumption in Kilowatt Hours per Pound of Ammonia Removed



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Discover how nanobubble pretreatment solves common wastewater challenges:
www.moleaer.com/en-us/industries/wastewater