Executive Summary

WERF

A paradigm shift is possible – moving deammonification to mainstream implementation

Aerial view of Chesapeake Elizabeth Treatment Plant, one of the participating facilities.

Mainstream Deammonification (INFR6R11)

The Central Issue

Significant amounts of energy are used to provide aeration during biological nutrient removal for wastewater treatment; frequently making these plants the largest users of energy in a municipality. As a result, energy-neutral or even energy-positive treatment options are needed. Applying the deammonification concept in the mainstream treatment process could reduce wastewater utilities' operational costs for aeration and significantly reduce external carbon costs.

Context and Background

The deammonification process for nitrogen removal provides a more efficient biological pathway compared to traditional nitrification/denitrification processes. The demonstrated advantages of applying deammonification to mainstream treatment include reduction of aeration energy, external carbon, and alkalinity demands. Deammonification requires significantly less oxygen and so less energy is needed for nitrogen removal. It requires no external carbon addition, eliminating purchase and storage of chemicals such as methanol.

This research built on deammonification concepts recently used in sidestream treatment. A multi-disciplinary team of researchers investigated whether, with minimal modification to certain types of existing plant configuration, the process could be applied to mainstream treatment.

Findings and Conclusions

The research concludes that mainstream deammonification can be achieved. In nine concept studies, the research team demonstrated that it is possible for wastewater treatment plants to retrofit to short-cut nitrogen removal using existing infrastructure, often with minor modifications. Short-cut nitrogen removal includes nitritation-denitritation, in which ammonia oxidation ends at the intermediate nitrite, with the mainstream deammonification pathway. Both short-cut nitrogen removal pathways result in savings in energy, carbon, and alkalinity over conventional nitrification-denitrification.

The concept studies illustrate that for many facilities, the nitrite-shunt approach provides the most obvious pathway to reduce operational costs as a first step. Further, the concept studies also show that mainstream deammonification is most beneficial in facilities with a low wastewater carbon to nitrogen (C/N) ratio where operators seek to meet low effluent nitrogen limits. Shifting more carbon away from secondary treatment (to push more solids to anaerobic digestion for energy generation), decreases the C/N ratio and maximizes energy recovery by diverting more particulate organic carbon away from the nitrogen removal process and directing it toward anaerobic treatment from which methane can be captured. Further research is required to incorporate biological phosphorus removal with short-cut nitrogen removal.

Management and Policy Implications

The implications of deammonification for cost effective and energy positive wastewater treatment are substantial. The successful application of mainstream deammonification could provide substantial savings to wastewater utilities operations. The concept studies presented in this research indicate that implementation of short-cut nitrogen removal; including mainstream deammonification can be retrofitted using existing infrastructure, often with minor modifications.

Participating Water Resource Recovery Facilities

- Chesapeake Elizabeth Treatment Plant, VA
- Blue Plains Advanced Wastewater Treatment Plant, Washington, D.C.
- H.L. Mooney Advanced Water Reclamation Facility, VA
- Robert W. Hite Treatment Facility, CO
- Egan Reclamation Plant, IL
- McDowell Creek Wastewater Treatment Plant, NC
- Sacramento Regional Wastewater Treatment Plant, CA
- Howard F. Curren Advanced Wastewater Treatment Plant, FL
- Danbury Water Pollution Control Plant, CT

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Mainstream Deammonification

Related WERF Research

Project Title	Research Focus
Nutrient Management Compendium Documents (NUTR1R06g)	Presents some of the key questions related to the deammonification process in a frequently asked question and answer format.
Technologies for Sidestream Nitrogen Removal (NUTR1R06w)	Reviews technologies for the treatment of nutrient-rich industrial wastewaters and recycle streams ("sidestream") generated by the dewatering of digested municipal sludges, animal manures, and source separated wastes.
Shortcut Nitrogen Removal – Nitrite Shunt and Deammonification (Special WERF/WEF Publication)	Provides owners, managers, engineers, operators, and researchers with a solid understanding of shortcut nitrogen removal, and the most current research and cutting-edge industry practices on how to implement these emerging resource-saving technologies in a sustainable manner.
Short-Cut Nitrogen Removal Consensus Document (LIFT5C14)	Consolidates the state of knowledge and the state of practice of shortcut nitrogen removal processes to allow owners and practitioners to implement these attractive emerging technologies at a reasonable assurance of the longevity of the approach while minimizing the risk of stranding assets.
Stabilization of Main Plant Nitritation/ Denitritation Performance (U5R12)	Focuses on resolving the identified specific underlying issues, both fundamental and practical, that hampered consistent nitritation performance and translation of the mainstream nitritation/ denitritation process to other facilities.
Development and Implementation of a Process Technology Toolbox for Sustainable Biological Nitrogen Removal Using Mainstream Deammonification (STAR_N2R14)	Develops a science and technology-driven approach and process toolbox for a cost-effective and energy-efficient BNR via mainstream deammonification.

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