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Measuring nitrogen transformations in onsite wastewater treatment systems (OWTS)

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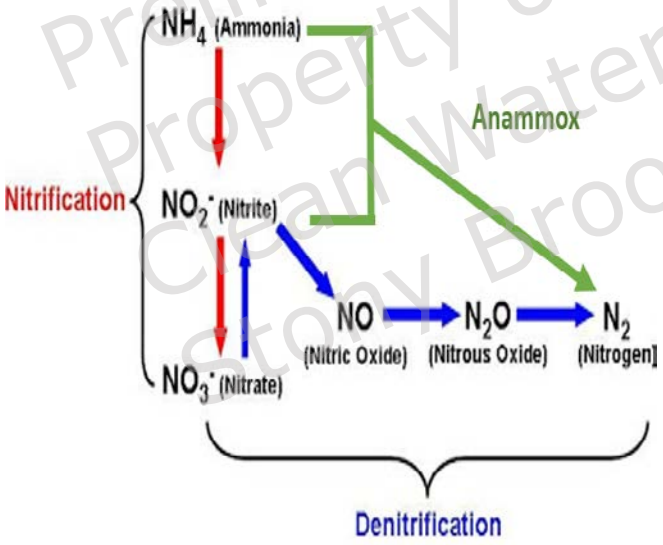
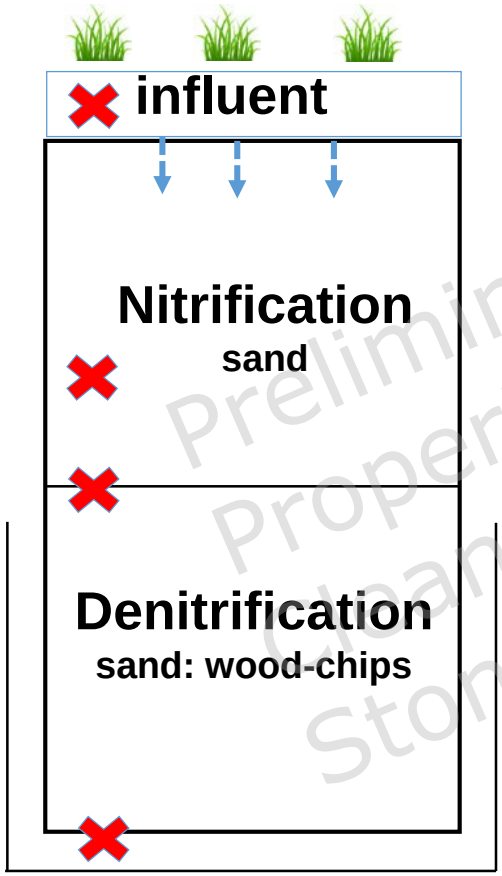
Reasons to measure nitrogen transformations in OWTS systems

- Extensive literature on large-scale WWTPs; little research published on OWTS.
- OWTS have different architecture, hydrology & even influent.
- To design optimal systems, we need to do applied research.



System Design

Characterizing nitrogen transformations spatially in a nitrogen reducing biofilter (NRB)



Basic questions:

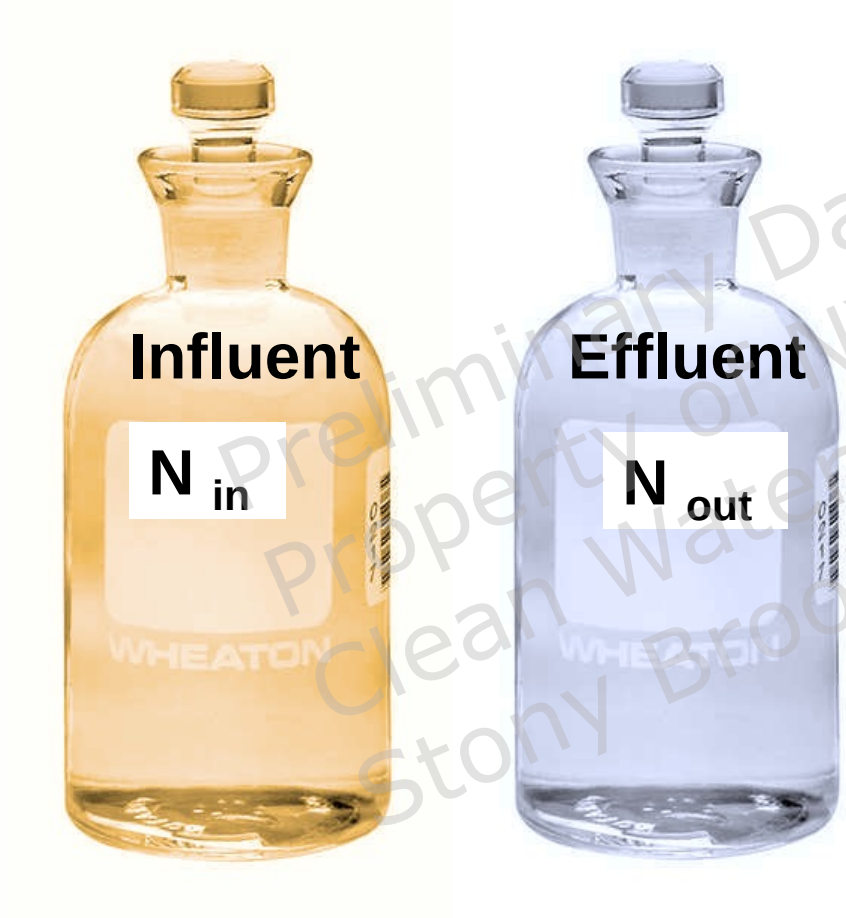
Is system optimally configured? (e.g., dimensions & materials)

Right quantity of alkalinity in nitrification layer?

Is oxygen low & carbon source sufficient enough for denitrification?

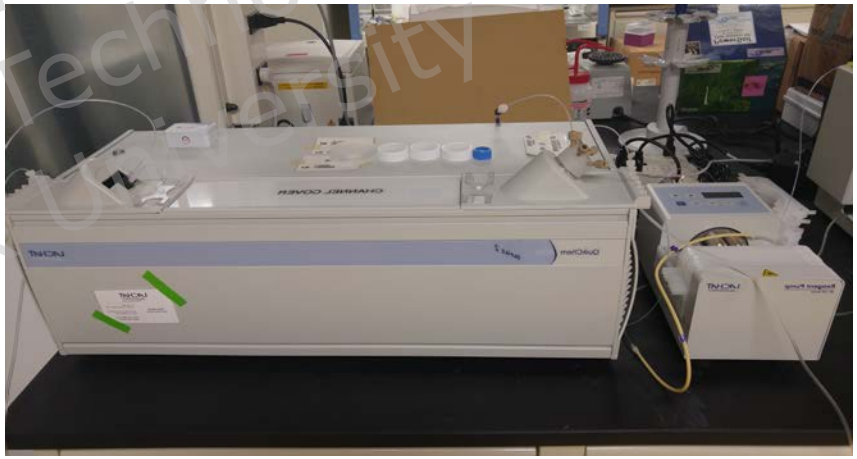
Does nitrogen loss = N_2 production or is another process at work?

Nitrogen removal efficiency: a basic way to compare different systems



N removal efficiency = 1- (N_{out} / N_{in})

Lachat auto-analyzer



NH_4^+, TkN, NO_3^-, NO_2^- & TN

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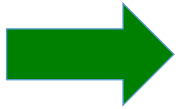
NYS CCWT analytical equipment

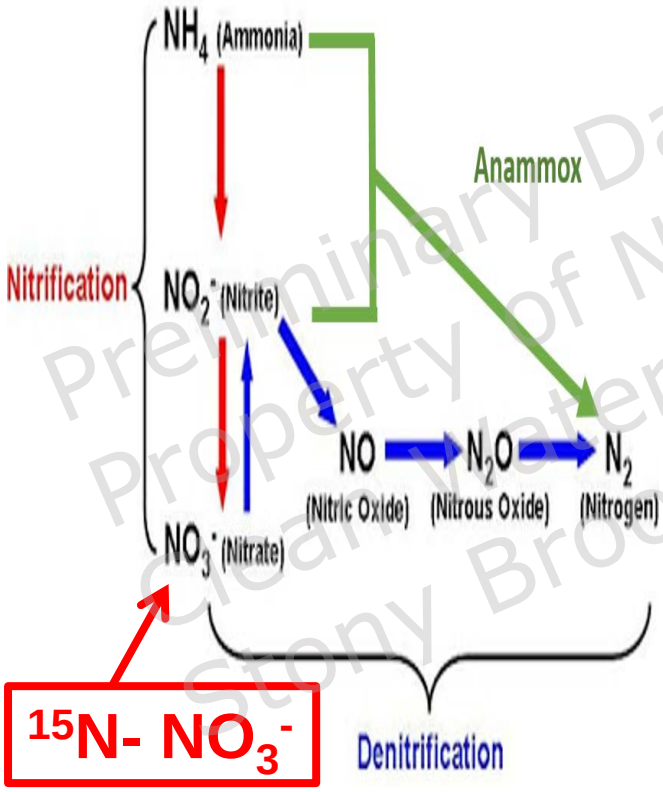
Membrane Inlet Mass Spectrometer (MiMS)



N_2

Gas Chromatograph

Isotopic additions (^{15}N) to distinguish anammox from denitrification using MiMS



^{15}N-NO_3^- additions to anoxic bench-scale incubations of sand:wood-chip mix.

Because no indigenous NO_3^- and all NH_4^+ in form of ^{14}N-NH_4^+, only possible outcomes:

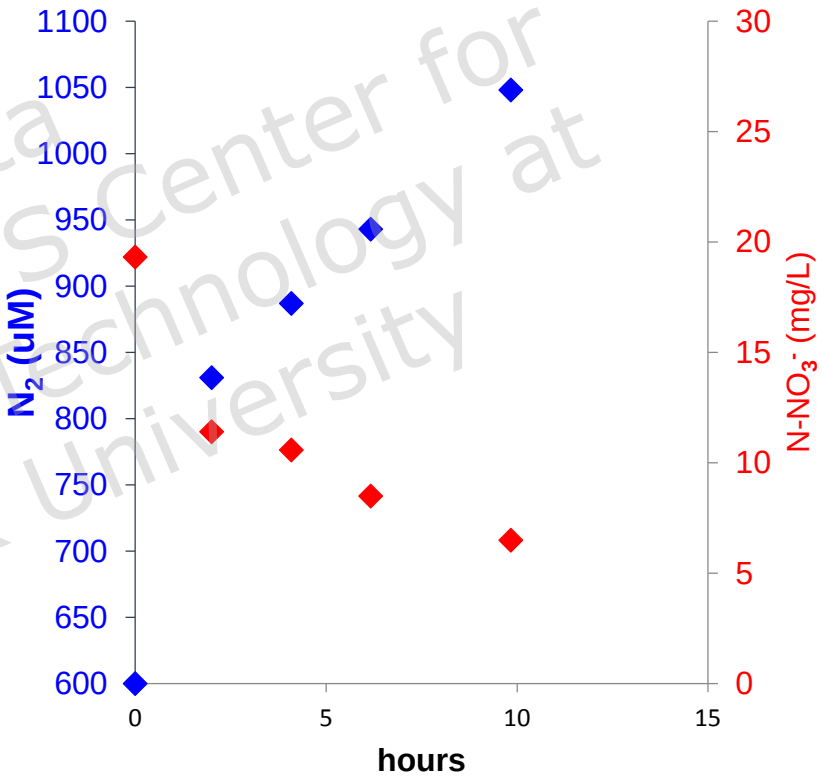
(1) $^{15}NO_3^- + {}^{14}NH_4^+ \rightarrow {}^{29}N_2$ anammox

(1) $^{15}NO_3^- + {}^{15}NO_3^- \rightarrow {}^{30}N_2$ denitrification

Use measurements to select system parameters which produce highest % anammox relative to % denitrification.

Advantages of MiMS & GC in bench-scale experiments:

- Efficiently test competing materials for in-ground designs
- Assess impacts of contaminants (e.g., surfactants, metals) in waste streams on N_2 production



Summary: measurement of nitrogen transformations

- Installed capacity for measurement of **NH_4^+, TkN, NO_3^-, NO_2^-, N_2 & N_2O**
- Combined experience in N measurements = decades **+**
- Two dedicated Ph.D. students: Molly Graffam & Samantha Roberts
- Support of & access to SBU faculty
- Unique collaboration of marine researchers (biogeochemists & microbiologists) with environmental & chemical engineers all oriented to one common purpose