Evaluating Nitrite Production in Anaerobic Baffled Reactors to Support Anammox Bacteria for Sustainable Nitrogen Removal

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INTRODUCTION

Anaerobic Baffled Reactors (ABRs):

- Sustainable decentralized wastewater treatment system
- Reuses wastewater for irrigation
- Does not remove harmful N compounds

Anaerobic ammonium oxidizing bacteria (anammox):

- Remove ammonium from wastewater
- Requires nitrite (NO_2-) present
- Inhibited by biodegradable organic matter

Figure 1. Anammox biomass.

Sulfamethoxazole (SMX):

- Antibiotic used to treat infections
- Contains nitrogen
- Promotes harmful antibiotic-resistant bacteria.

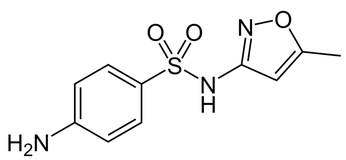

Figure 2. Sulfamethoxazole molecule

METHODS

Flow of System

Total Feeding Cycle (Hour)	Time Running (Hour)	Time Stagnant (Hour)	Flow Rate (L/Hour)	Hydraulic Retention Time (Hour)
24	1	3	0.8	34

Constituent	Instrument
Nitrate Nitrite	Dionex Ion Chromatogram
Ammonium	Hanna HR Ammonium Colorimeter
pH Electroconductivity	Mettler Toledo SevenGo Duo pH and Conductivity Meter
Chemical Oxygen Demand	Hach TNT Kit 825 and Hach DRB 200
Fluorescence	Horiba Aqualog Scanning Spectrophotometer

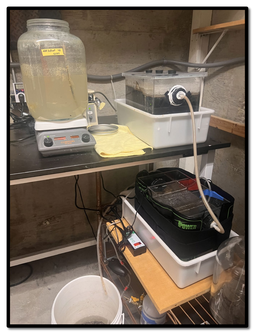

Figure 3. Experimental ABR setup.

Bioelectrochemical System

- Anode in A2C1 induces ammonium oxidation
- 0.5V is applied

Intermittent Aeration

- Intermittent aeration is applied to Baffle 4
- 15 minutes on, and 30 minutes off

DUAL ANAEROBIC BAFFLED REACTOR SETUP

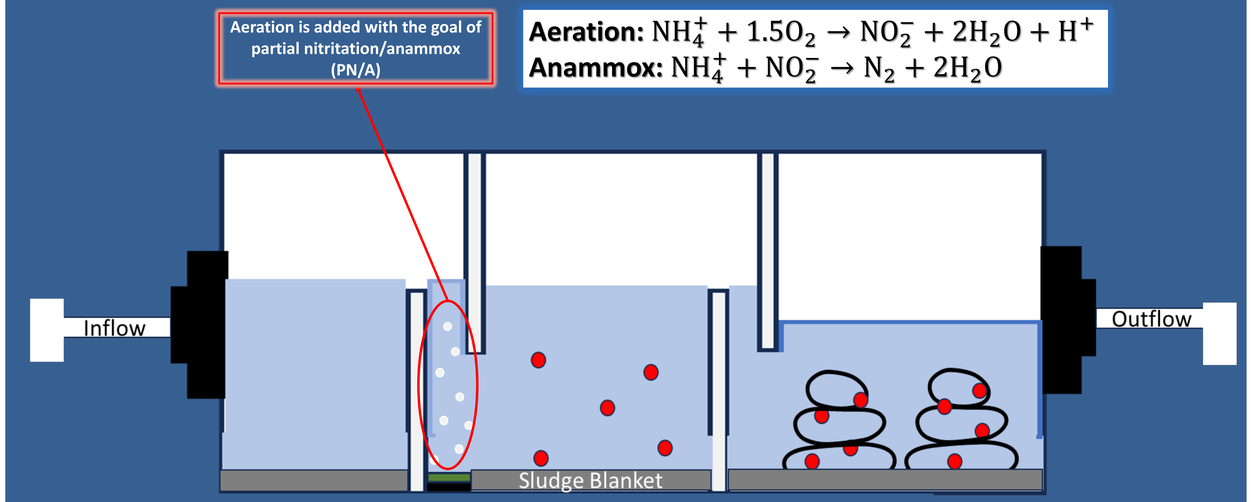

Figure 4. Schematic of partial nitritation setup in ABR-2.

Vs.

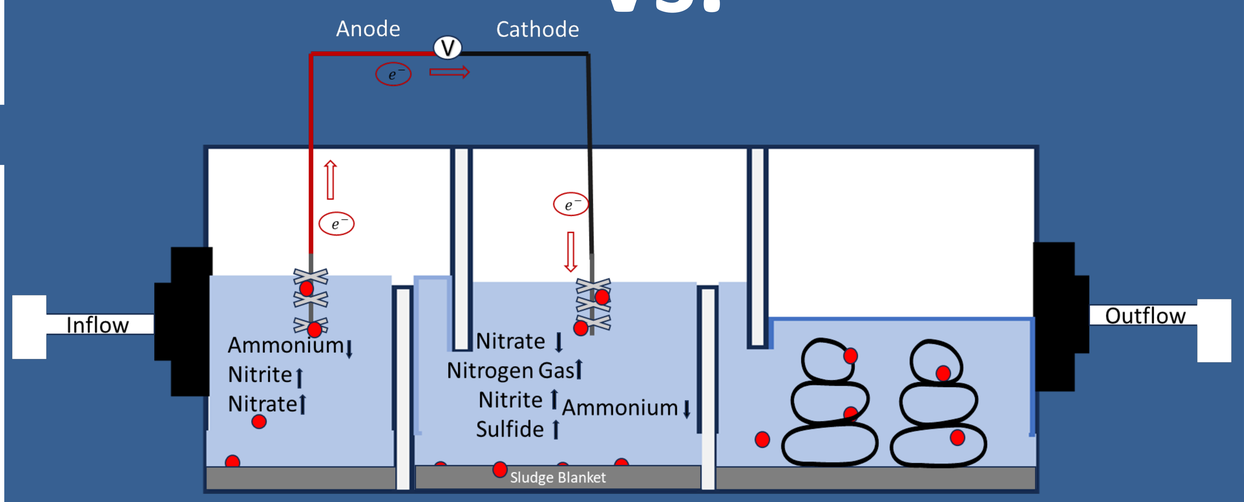

Figure 5. Schematic of Bioelectrochemical system in ABR-2.

Motivation:

Optimizing the growth of anammox bacteria in anaerobic baffled reactors will enable a widespread implementation of the system for nitrogen removal.

RESULTS

	Chamber 1	Chamber 2	Chamber 3
Average Reduction of Tryptophan Peak (%)	17.34	41.45	**68.47**
Average Reduction of DOC (%)	64.9	83.0	**91.4**
Freshness Index	0.92	0.92	0.90

Table 1. Reduction of constituents associated with organic carbon through ABR 1.

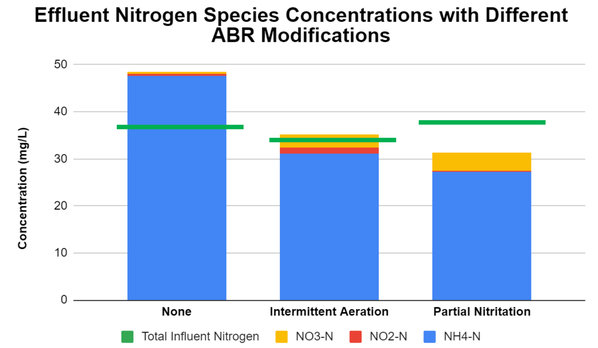

Figure 6. Comparison of nitrogen species dynamics with different anaerobic baffled reactor modifications

FUTURE WORK

Preliminary Results:

- 70% COD removal through ABR 1 was achieved in 234 days
- After 100 days, ammonium removal reached 33% through ABR-2 and 25% through the whole system

Future Work:

- Continue evaluating bioelctrochemical system
- Check growth of anammox with anammox activity tests
- Incubate SMX+anammox and measure changes in SMX concentrations with HPLC.

REFERENCES

Jason B. Fellman, E. H. (2010). Fluorescence spectroscopy opens new windows into dissolved organic matter dynamics in freshwater ecosystems: A review. *the American Society of Limnology and Oceanography, Inc.*

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