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# Demonstration of practical mainstream deammonification schemes balancing treatment efficiency with complexity and cost

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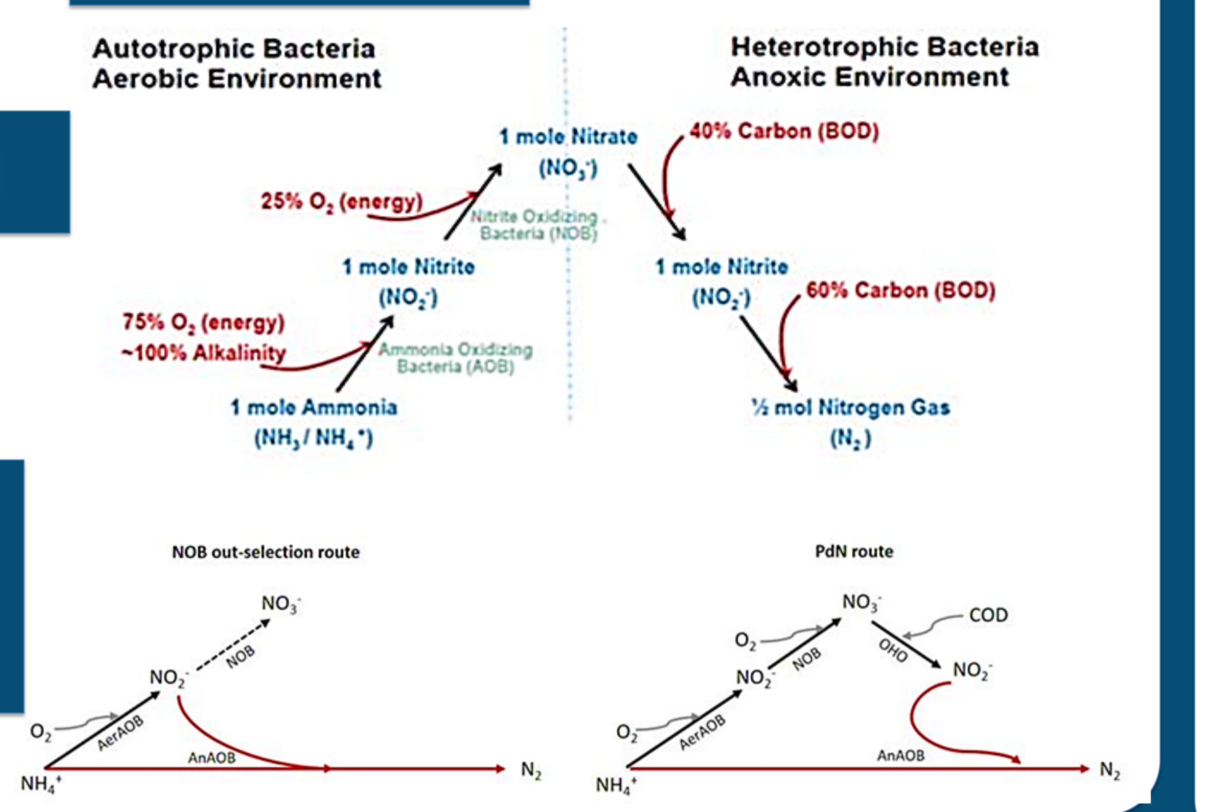
## Introduction

**Conventional**

**VS**

**Short-Cut Nitrogen Removal**




## Blue Plains Advanced Wastewater Treatment Plant

- 1400 MLD plant
- Stringent limits:
  TN < 3.8 mg TN/L
  TP < 0.18 mg P/L
- Conventional BNR system
- Costs per year:
  **$8M** for methanol dosing
  $1.5M for aeration
  $0.6M on alkalinity

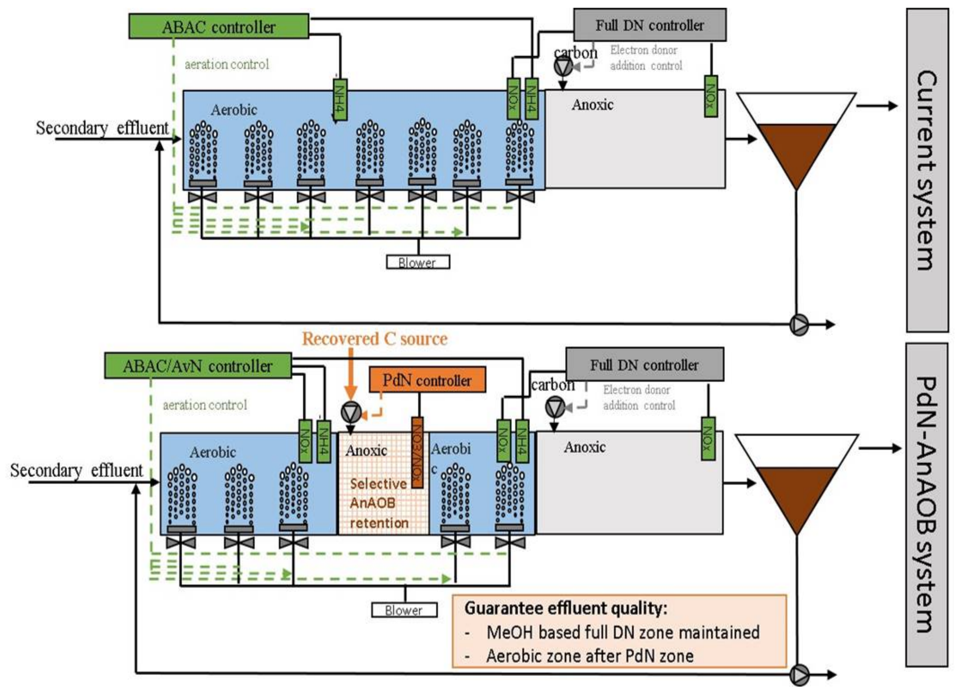
## Hurdles to full-scale mainstream deammonification

- Challenge and unreliability of NOB out-selection due to system and seasonal dynamics.
- Capital investment requirements because of the limitation of existing infrastructure.
- Risk of implementation and violation of effluent limits, especially with significant reliance on anoxic ammonium oxidixing bacteria (AnAOB) contribution.

## Objectives

1. Develop novel and risk adverse concepts to boost full scale adoption of PdN-AnAOB mainstream deammonification.
2. Assess the impact of the combination of different aeration modes and partial denitrification on nitrogen removal treatment.
3. Analyze the operational cost savings when incorporating partial denitrification with anammox in Blue Plains Advanced wastewater treatment plant

## Materials and Methods

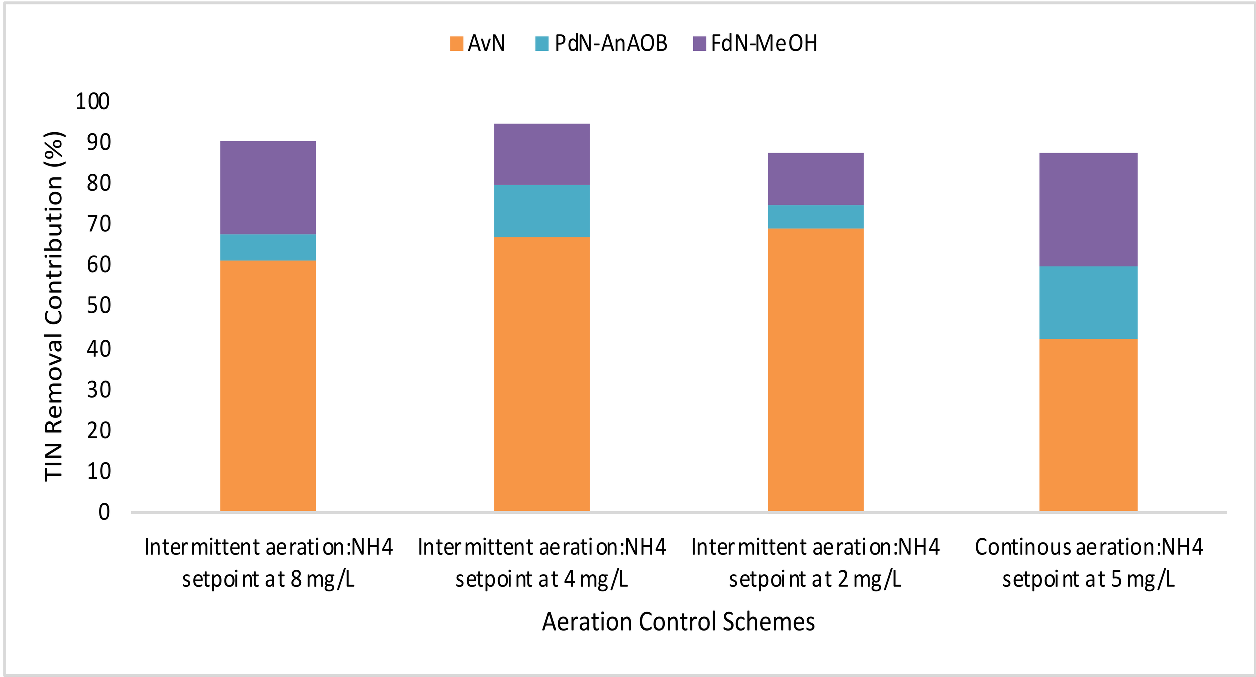



Intermittent Aeration → Aerobic DO concentration: 1.5 mg $O_2$/L
Anoxic DO concentration: 0 mg $O_2$/L

Continuous Aeration → DO concentration varying between 0.1-3 mg $O_2$/L

## Results

**Total nitrogen removal contributions for intermittent and continuous aeration**




**Cost comparison coupled with AnAOB contribution for 4 different scenarios**

| | Scenario A | Scenario B | Scenario C | Scenario D | Scenario E |
|---|---|---|---|---|---|
| **Configuration** | | | | | |
| Aeration control | Continuous | Continuous | Continuous | Intermittent | Intermittent |
| PdN-AnAOB | No | No | Yes | No | Yes |
| Full DN with MeOH | Yes | Yes | Yes | Yes | Yes |
| **Concentration profiles** | | | | | |
| Influent (mg TIN/L) | 30 | 30 | 30 | 30 | 30 |
| Effluent (mg TIN/L) | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Ammonium at end of aeration zone (mg N/L) | 0 | 5 | 5 | 5 | 5 |
| NO3 concentration into PdN zone (mg N/L) | - | 11.8 | 11.8 | 4 | 4 |
| Amount of NO3 to be removed with MeOH | 30 | 15.8 | 9.2 | 8 | 4.4 |
| **TIN removal contributions** | | | | | |
| AvN control based on ww carbon (%) | 0 | 44 | 44 | 70 | 70 |
| PdN-AnAOB (%) | 0 | 0 | 22 | 0 | 12 |
| FdN with MeOH (%) | 100 | 48 | 26 | 22 | 10 |
| **MeOH needs** | | | | | |
| g MeOH-COD added per g TIN removed | 3.60 | 1.87 | 1.01 | 0.85 | 0.38 |

## Conclusions

- Fail safe implementation of mainstream deammonification is crucial for meeting effluent permit limits.
- Improved aeration control (intermittent) leads to greater treatment and cost efficiency.
- PdN-AnAOB application in conjunction leads to **74% reduction in MeOH cost,** similar to an application of solely intermittent and full denitrification with MeOH.

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