### Mitigating N2O Emissions From a Fulls-Scale Anammox Reactor December 2018

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#### Ejby Mølle WWTP





![](_page_1_Picture_3.jpeg)

![](_page_2_Figure_0.jpeg)

![](_page_2_Figure_1.jpeg)

![](_page_2_Picture_2.jpeg)

#### Sidestream anammox at Ejby Mølle

![](_page_3_Picture_1.jpeg)

Continuos (not Batch) operation
Volume: 320m<sup>3</sup> each
Load: 0,66 kg NH4-N/m<sup>3</sup>

![](_page_3_Picture_3.jpeg)

![](_page_3_Picture_4.jpeg)

![](_page_4_Picture_0.jpeg)

![](_page_4_Figure_1.jpeg)

![](_page_4_Picture_2.jpeg)

Demon<sup>™</sup> Hydrocylone for decoupled SRT + "washing"

![](_page_4_Picture_4.jpeg)

### Background: Liquid N2O on-line measurements and off-gas campaigns

![](_page_5_Figure_1.jpeg)

![](_page_5_Picture_2.jpeg)

#### N<sub>2</sub>O produced during anoxic phase

![](_page_6_Figure_1.jpeg)

![](_page_6_Picture_2.jpeg)

### **Challenge:** provide enough oxygen for AOB to use it as electron acceptor, but low enough for simultaneous anammox growth

#### **Continuous aeration:**

airflow control based on ammonia feedback + no washing

![](_page_7_Picture_3.jpeg)

**Control reactor:** nitritebased/pH/ time-based intermittent aeration.

![](_page_7_Picture_5.jpeg)

# Continuous aeration research questions

- Can we keep nitrogen removal with low oxygen concentrations?
- Will NOB out-compete anammox?
- Eliminate nitrifierdenitrification pathway for N2O?
- Size of the granules: key to prevent oxygen inhibition in granules. Effect of stop washing?

![](_page_8_Figure_5.jpeg)

![](_page_8_Picture_6.jpeg)

#### Nitrogen removal as %

![](_page_9_Figure_1.jpeg)

![](_page_9_Picture_2.jpeg)

#### Does nitrite accumulate?

![](_page_10_Figure_1.jpeg)

![](_page_10_Picture_2.jpeg)

#### Will NOB outcompete anammox?

![](_page_11_Figure_1.jpeg)

![](_page_11_Picture_2.jpeg)

### NOB out-selection during continuous aeration

![](_page_12_Figure_1.jpeg)

![](_page_12_Picture_2.jpeg)

### Lower N<sub>2</sub>O emissions by continuos aeration

![](_page_13_Figure_1.jpeg)

![](_page_13_Picture_2.jpeg)

## Continuous aeration research answers

- Can we keep nitrogen removal with low oxygen concentrations?
- Will NOB out-compete anammox?
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- Size of the granules: key to prevent oxygen inhibition in granules. Effect of stop washing?

![](_page_14_Picture_5.jpeg)

![](_page_14_Picture_6.jpeg)

#### What about "washing" the sludge?

![](_page_15_Picture_1.jpeg)

![](_page_15_Picture_2.jpeg)

## Energy savings from not running washing mode

![](_page_16_Figure_1.jpeg)

![](_page_16_Picture_2.jpeg)

### Conclusions

- Granular nature of anammox allows for simultaneous nitrification-deammonification in a hibrid configuration
- Oxygen always present as preferred electron acceptor for AOBs + nitrite sink = N2O reduction
- Study identified significant operational improvements:
  - 50% lower nitrous oxide emissions on average by running continuos aeration compared to control reactor
  - 15% energy savings by not running the hydrocylone in "washing mode"
  - Less chemical cleaning of the panel diffusers required

![](_page_17_Picture_7.jpeg)

![](_page_17_Picture_8.jpeg)

![](_page_17_Picture_9.jpeg)

#### Thank you

![](_page_18_Picture_1.jpeg)

![](_page_18_Picture_2.jpeg)