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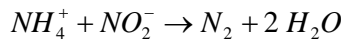
Objectives

The start-up and operation of an Anammox SBR reactor was modelled with the Activated Sludge model Nr. 1 extended for Anammox. The simulations helped interpreting the experimental results and showed that both Anammox as heterotroph biomass were active in the reactor.

Introduction

• Anammox

- Anammox is a novel process for nitrogen removal (Jetten et al., 1999). Ammonium is oxidised using nitrite as electron acceptor:



- Anammox organisms are slow growing organisms (doubling time 11 days) and are reversibly inhibited by oxygen and nitrite.

Materials & Methods

•The experimental set-up

- The experimental SBR (Figure 1) was operated at 35°C and pH between 7.8 and 8. The hydraulic residence time (HRT) was 0.62 d. Influent NH_4^+ , NO_2^- and NO_3^- concentrations are depicted in Figure 2. Settling was ideal, but the non-settling fraction was assumed to 0.5 % to account for sampling

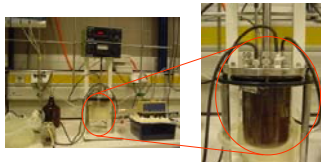


Figure 1. The experimental SBR

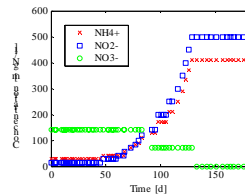


Figure 2. The influent concentrations to the SBR

•Extension of ASM1: ASM1.e

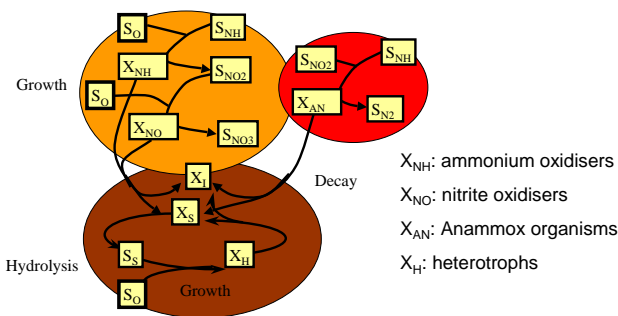


Figure 3. The ASM1.e model (Hao et. al., 2002; Sin et al., 2001)

References

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•Anammox kinetics and stoichiometry

• Growth: $\mu = \mu_{AN}^{max} \frac{K_{O_2,AN}^i S_{O_2}}{S_{O_2} + K_{O_2,AN}^i} \frac{S_{NH}}{S_{NH} + K_{NH,AN}} \frac{S_{NO_2}}{S_{NO_2} + K_{NO_2,AN}} X_{AN}$

• Decay: $b = b_{AN} X_{AN}$

• Stoichiometry:

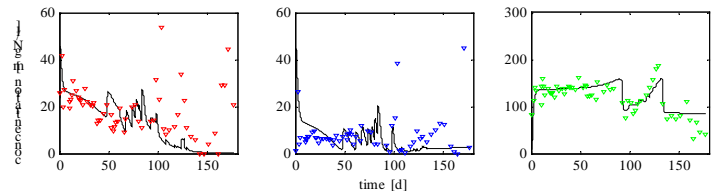
	S_{NH}	S_{NO_2}	S_{NO_3}	S_{O_2}	X_{AN}	X_S	X_I
Growth of X_{AN}	$-1/Y_{AN}$	$-1/Y_{AN}$	$-1.52+1/Y_{AN}$	1.52	$2/Y_{AN}$	1	1
Decay of X_{AN}	$-f_{NH}$	$-f_{NO_2}$	$-f_{NO_3}$	$-f_{O_2}$	-1	$-(1-f_i)$	f_i

• Parameters:

symbol	definition	Value (at 20°C)	unit	reference
Y_{AN}	Autotrophic yield on ammonia for X_{AN}	0.159	gCOD/gN	Strous et al. (1998)
μ_{AN}^{max}	Maximum growth rate of X_{AN}	0.0195	d ⁻¹	Strous et al. (1998)
$K_{O_2,AN}^i$	Inhibition constant for S_{O_2}	0.01	gO ₂ /m ³	Strous et al. (1998)
$K_{NH,AN}$	Saturation constant for S_{NH}	0.3	gN/m ³	This study
$K_{NO_2,AN}$	Saturation constant for S_{NO_2}	0.3	gN/m ³	This study
b_{AN}	Decay rate of X_{AN}	0.002	d ⁻¹	This study

Results & Discussion

- In Figure 4 the simulated effluent concentrations are depicted. It can be seen that there is a good agreement between measured and simulation results. Also the effluent concentrations are low, indicating the possibility of the Anammox reactor to treat nitrogen rich streams.



•Figure 4. The calculated (—) and measured (v) ammonium (left), nitrite (middle) and nitrate (right) concentrations in the effluent of the SBR

- In Figure 5 the simulated Anammox and inert biomass concentrations are presented. From day 100 a gradual colour change from brownish to reddish was observed. This colour change can be explained by the gradually increasing Anammox biomass concentration. This shows the successful enrichment of Anammox organisms over the experimental period.

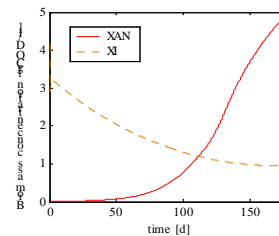


Figure 5. The calculated Anammox (—) and inert biomass (---) concentrations in the SBR

CONCLUSIONS

- Simulation results of both start-up and dynamic operation of an Anammox SBR reactor were compared to the measured values, using ASM1 extended with a 2 step nitrification-denitrification model and with the Anammox process. The Anammox biomass concentration increased gradually over the experimental period, showing the successful enrichment of Anammox organisms in an SBR reactor.