Supplementary Materials: Performance and N_2O Formation of the Deammonification Process by Suspended Sludge and Biofilm Systems—A Pilot-Scale Study

Carmen Leix, Rebecca Hartl, Christian Zeh, Franz Beer, Jörg E. Drewes and Konrad Koch

Figure S1. Two-stage deammonification pilot plant in Kempten (Allgäu): (**a**) Overview (1: Sedimentation; 2: Nitritation; 3: Buffer tank; 4a: Moving bed biofilm reactor (MBBR) with biofilm carriers; 4b: Sequencing batch reactor (SBR) with suspended sludge); (**b**) SBR with suspended sludge; (**c**) MBBR with biofilm carriers.

Figure S2. Pictures of aeration elements (**left**: calcified membrane tube; **right**: recurrently acidified membrane plate).

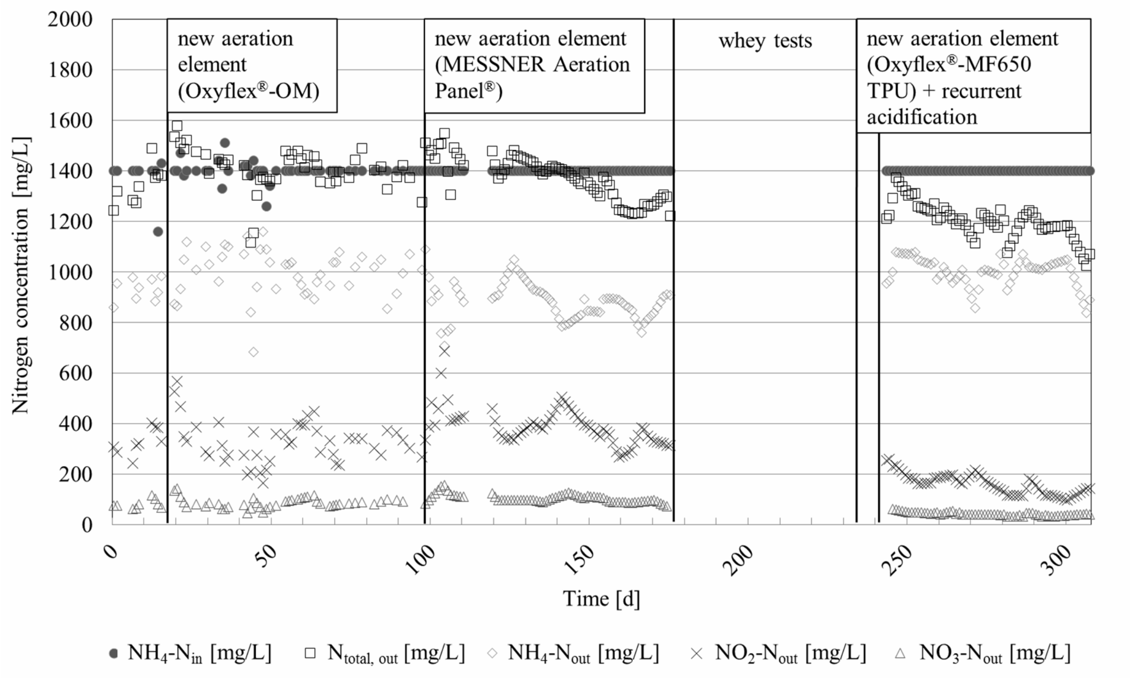

Figure S3. Performance of nitritation in combination with downstream SBR in 2014 (NH_4-N_{in} was assumed to be 1400 mg/L for the rest of the year after stable development during observation in February and March).

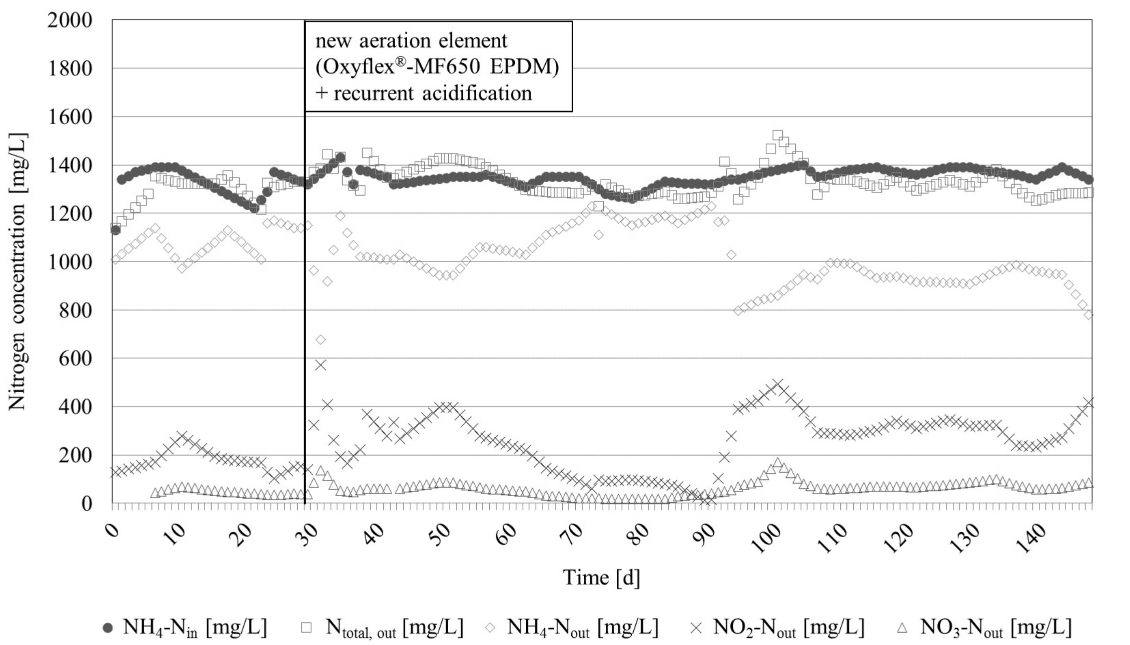

Figure S4. Performance of nitritation in combination with downstream MBBR in 2015.

Table S1. Respiratory AOB and NOB activity tests of SBR *.

	Respiratory Activity [g O_2/(g VSS·Day)]	**Conversion Rates [g N/(kg VSS·Day)]**
AOB	1.13	330
NOB	0.08	72

Notes: * The respiratory activity of ammonium oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB) was investigated ex situ over the oxygen consumption and correlated to the volatile suspended solids concentration (VSS). For AOB activity only, sodium azide (NaN_3) was added with a final concentration of 1 mg N/L for the inhibition of NOBs. For NOB activity only, allylthiourea (ATH) was added to a final concentration of 5 mg ATH/L for the inhibition of AOBs. For all tests, supply of sufficient substrate (ammonium and additionally nitrite for the NOB activity test) needed to be ensured. Sludge was aerated until oxygen saturation and oxygen consumption was monitored. According to the stoichiometry, 3.43 g O_2/(g NH_4-N) are necessary for the ammonium oxidation, whereas 1.14 g O_2/(g NO_2-N) are needed for the nitrite oxidation. Results of activity tests indicate a strong abundance of AOBs besides a successful suppression of NOBs in the second stage of the deammonification plant and therefore are evidence—apart from the calculated single-stage ammonium conversion rates—that the second stage partly acted as a single-stage deammonification process.

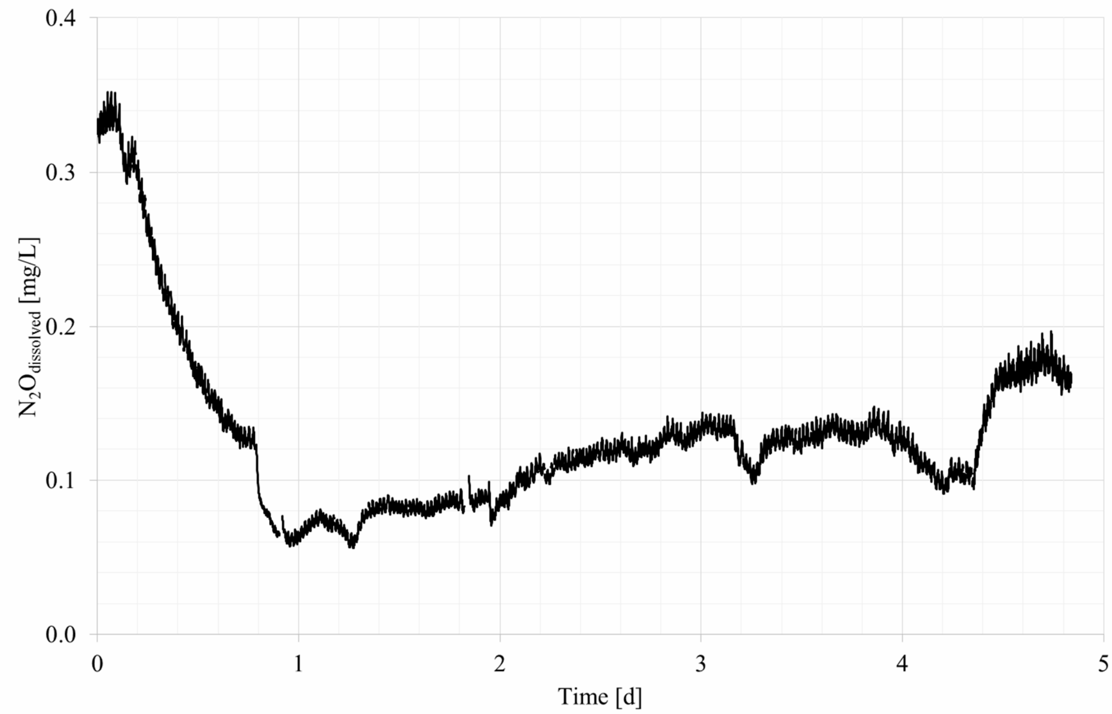

Figure S5. Dissolved nitrous oxide concentration in the nitritation.

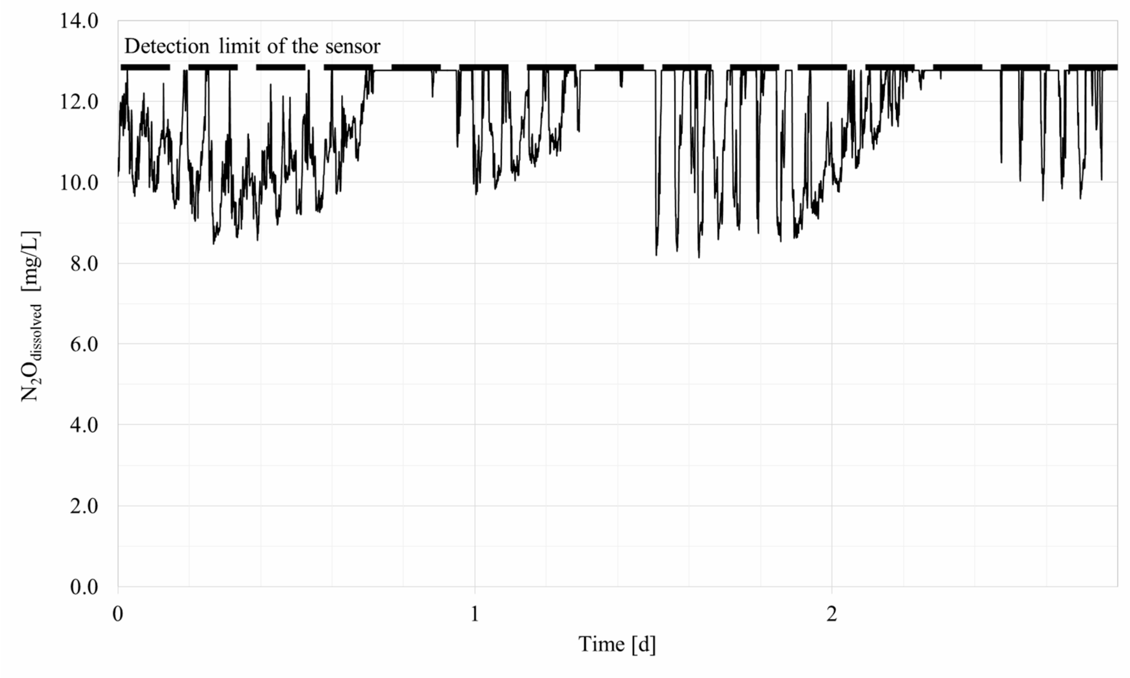

Figure S6. Dissolved nitrous oxide concentration in the buffer tank.

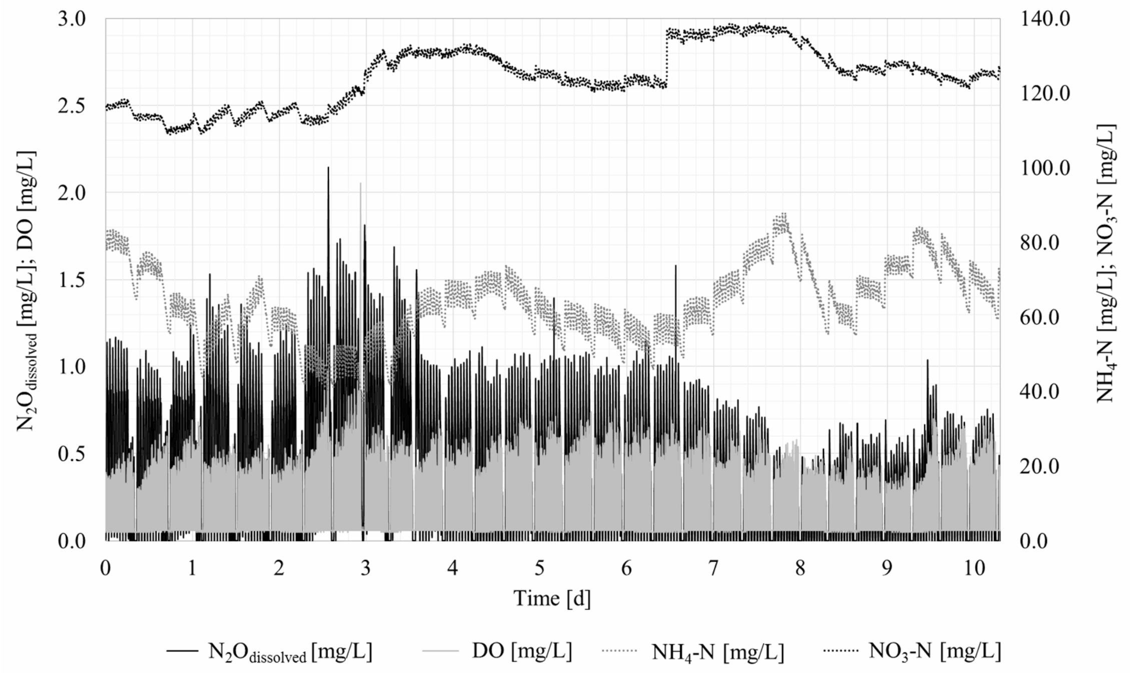

Figure S7. Dissolved nitrous oxide, dissolved oxygen, ammonium, and nitrate concentrations in the SBR.

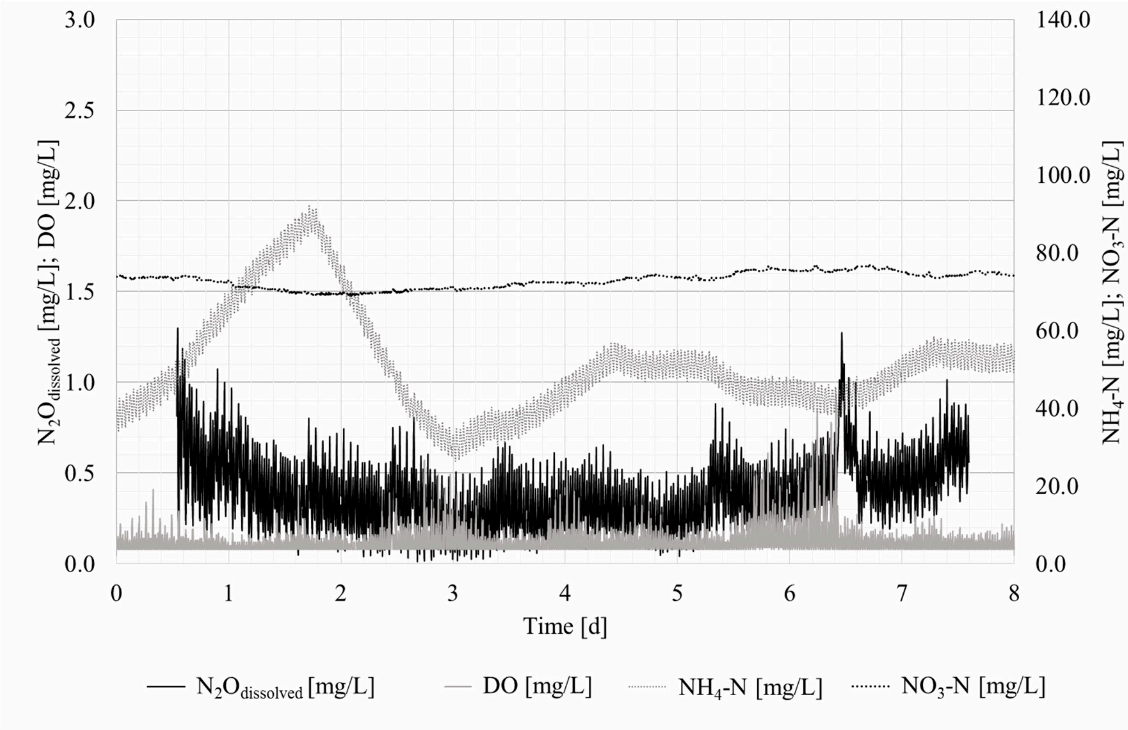

Figure S8. Dissolved nitrous oxide, dissolved oxygen, ammonium, and nitrate concentrations in the MBBR operated as a single-stage deammonification process.