A two-stage deammonification pilot plant with two different second-stage reactors, namely a sequencing batch reactor (SBR) with suspended sludge and a moving bed biofilm reactor (MBBR) with biofilm carriers, was investigated over a 1.5-year period to compare reactor performances. Additionally, dissolved nitrous oxide (N2O) was measured to determine the reactors’ N2O formation potential. Although the nitritation performance was moderate (NO2-N/NH4-N effluent ratio of 0.32 ± 0.15 in combination with SBR and 0.25 ± 0.14 with MBBR), nitrogen turnover and degradation rates exceeding 500 g N/(m3 day) and 80%, respectively, were achieved in both second stages, yet requiring additional aeration. The SBR’s average nitrogen removal was 19% higher than the MBBR’s; however, the SBR’s nitrite influent concentration was comparably elevated. Concerning N2O formation, the nitritation reactor exhibited the lowest N2O concentrations, while the buffer tank, interconnecting the first and second stages, exhibited the highest N2O concentrations of all reactors. Given these high concentrations, a transfer of N2O into the second stage was observed, where anoxic phases enabled N2O reduction. Frequent biomass removal and a decreased hydraulic retention time in the buffer tank would likely minimize N2O formation. For the second stage, enabling anoxic
periods in the intermittent aeration cycles right after feeding to support N2O reduction and thus minimize the stripping effects or the implementation of a complete anoxic ammonium oxidation will mitigate N2O emissions.

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