Successful mainstream nitritation through NOB inactivation

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The development of new wastewater treatment processes can assist in reducing the impact of wastewater treatment on the environment. The recently developed partial nitritation anammox (PNA) process, for example, consumes less energy for aeration and reduces nitrate in the effluent without requiring additional organic carbon. However, achieving stable nitritation (ammonium oxidation; NH4+ -> NO2-) at mainstream conditions (T = 10-25 degrees C, C:N 10, influent ammonium < 50 mgNH(4)-N/L and effluent < 1 mgNH(4)-N/L) remains challenging. This study explores the potential and mechanism of nitrite-oxidizing bacteria (NOB) suppression in a bottom-fed sequencing batch reactor (SBR). Two bench-scale (11 L) reactors and a pilot-scale reactor (8 m(3)) were operated for over a year and were fed with organic substrate depleted municipal wastewater. Initially, nitratation (nitrite oxidation; NO2- -> NO3-) occurred occasionally until an anaerobic phase was integrated into the operating cycle. The introduction of the anaerobic phase effectively suppressed the regrowth of NOB while nitritation was stable over 300 days, down to 8 degrees C and at ammonium influent concentrations < 25 mgNH(4)-N/L. Batch experiments and process data revealed that parameters typically affecting NOB growth (e.g., dissolved oxygen, alkalinity, trace elements, lag-phase after anoxia, free nitrous acid (FNA), free ammonia (FA), pH, sulfide, or solids retention time (SRT)) could not fully explain the suppression of nitratation. Experiments in which fresh nitrifying microbial biomass was added to the nitritation system indicated that NOB inactivation explained NOB suppression better than NOB washout at high SRT. This study concludes that bottom-fed SBRs with anaerobic phases allow for stable nitritation over a broad range of operational parameters. Coupling this type of SBR to an anammox reactor can enable efficient mainstream anammox-based wastewater treatment.
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