A novel fuzzy-logic control strategy minimizing N2O emissions

A novel fuzzy-logic control strategy for achieving low N₂O emissions and low effluent NH₄⁺ concentration is here proposed. The control strategy uses the measurements of ammonium and nitrate concentrations in inlet and outlet of the aerobic zone of a wastewater treatment plant to calculate a ratio indicating the balance among the microbial groups. More specifically, the ratio will indicate if there is a complete nitrification. In case nitrification is not complete, the controller will adjust the aeration level of the plant in order to inhibit the production of N₂O from AOB and HB denitrification. The controller was implemented using the fuzzy logic approach. It was comprehensively tested for different model structures and different sets of model parameters with regards to its ability of mitigating N₂O emissions for future applications in real wastewater treatment plants. It is concluded that the control strategy is useful for those plants having AOB denitrification as the main N₂O producing process. However, in treatment plants having incomplete NH₂OH oxidation as the main N₂O producing pathway, a cascade controller configuration adapting the oxygen supply to respect only the effluent ammonium concentration limits was found to be more effective to ensure low N₂O emissions.

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