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Hydrogenotrophic denitrification is a novel and sustainable process for nitrogen removal, which utilizes hydrogen as electron donor and carbon dioxide as carbon source. Recent studies have shown that nitrous oxide (N2O), a highly undesirable intermediate and potent greenhouse gas, can accumulate during this process. In this work, a new mathematical model is developed to describe nitrogen oxides dynamics, especially N2O, during hydrogenotrophic denitrification for the first time. The model describes electron competition among the four steps of hydrogenotrophic denitrification through decoupling hydrogen oxidation and nitrogen reduction processes using electron carriers, in contrast to the existing models that couple these two processes and also do not consider N2O accumulation. The developed model satisfactorily describes experimental data on nitrogen oxides dynamics obtained from two independent hydrogenotrophic denitrifying cultures under various hydrogen and nitrogen oxides supplying conditions, suggesting the validity and applicability of the model. The results indicated that N2O accumulation would not be intensified under hydrogen limiting conditions, due to the higher electron competition capacity of N2O reduction in comparison to nitrate and nitrite reduction during hydrogenotrophic denitrification. The model is expected to enhance our understanding of the process during hydrogenotrophic denitrification and the ability to predict N2O accumulation.

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