Comparing greenhouse gas emissions for different nitrogen removal technologies in wastewater treatment.

Level:	MSc.
Start of project:	Open
Project form:	Modeling study
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Background

Removal of nitrogenous compounds from wastewater is extremely important to prevent eutrophication of the receiving water bodies. However, it is also a very energy demanding process. Over the last decades, several novel technologies have been developed to reduce improve nitrogen removal.

Project aim

In this internship, you will quantify the differences greenhouse gas emissions for different (potential) nitrogen removal technologies applied in wastewater treatment. These include the classical tertiary treatment, where all ammonia is first converted into nitrate (full nitrification), with subsequent denitrification to convert nitrate to dinitrogen gas. While nitrification has a large oxygen demand, the latter step requires anaerobic conditions and addition of organic carbon, which increases costs and may results in additional greenhouse gas production and substantial sludge production. An emerging technology is PN/A, where partial nitrification (conversion of ammonia to nitrite) is coupled to anammox (anaerobic oxidation of ammonium). In these systems, only ~50% of the ammonium is converted into nitrite, which is then converted with the remaining ammonium to dinitrogen gas by anammox bacteria. PN/A systems have a reduced oxygenation demand, do not depend on organic carbon addition and have much less sludge production. At the department of Microbiology, we investigate possibilities to further reduce the environmental footprint of nitrogen removal in wastewater treatment plants. Here, nitrite comproportionation is used to couple the reduction of nitrate to the oxidation of ammonia to nitrite, a process hypothesized to be catalyzed by comammox (complete ammonia oxidizing) bacteria. Utilization of this process further reduces oxygenation demand compared to PN/A systems. Additionally, nitrate that is produced by anammox bacteria is removed simultaneously. In this internship, you will quantify the greenhouse gas emission and oxygen need per kg of nitrogen removed by the different technologies described above. The overall aim of the project is to investigate benefits and process feasibilities for the different nitrogen removal technologies.



References

Vineyard et al 2021
Hauck et al. 2016