Water Protection beyond Septic Tanks

Nitrogen Removal from Urine in On-site Reactors

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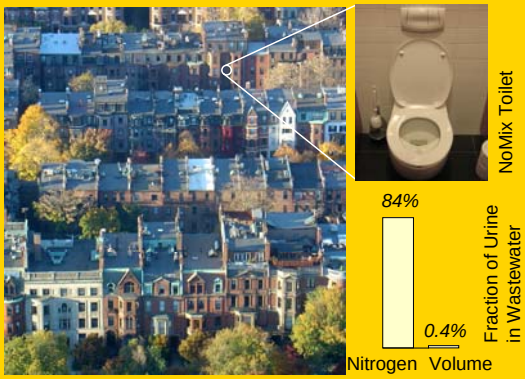
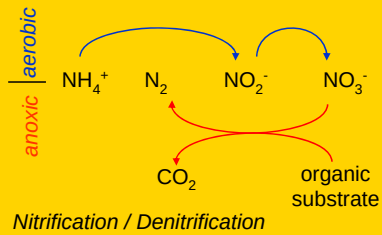


Background

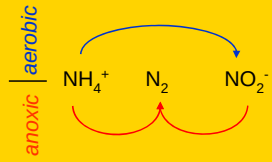
Nitrogen loads from untreated wastewater contribute substantially to the deterioration of coastal ecosystems worldwide. Today's approach to remove nitrogen from municipal wastewater are sewers and centralized treatment facilities. These systems are often not built or do not work properly due to financial, organizational and technological constraints. As an alternative, we propose decentralized separation and treatment of urine. The new reactors must remove nutrients reliably and at low costs. We tested a biological process: nitritation and anaerobic ammonium oxidation.

Treatment Process

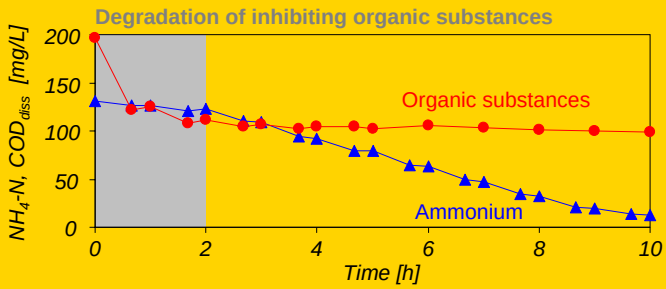
In conventional wastewater treatment plants, ammonium is eliminated via aerobic nitrification and anoxic denitrification. With the help of anaerobic ammonium oxidizing bacteria (anammox), the process can be shortened. No organic substrate is required and the oxygen consumption is reduced. Anammox bacteria are very sensitive to oxygen, but the process can be operated in a single sequencing batch reactor, if the oxygen concentration is kept low.



Nitrification / Denitrification



Nitritation / Anammox



Results

In laboratory experiments, nitrogen removal rates of 430 mgN/L/d where achieved with a nitrogen removal efficiency of 92%. With this performance, a reactor volume of 25 L (volume of a desktop computer) is sufficient to remove 75% of a person's daily nitrogen load. A conventional wastewater treatment plant requires ten times more volume for the same performance.

Further Research

Organic substances in urine foster the growth of heterotrophic bacteria. These bacteria support the nitritation/anammox process e.g. by removing inhibiting organic substances. Under certain conditions, however, heterotrophic bacteria can cause process instabilities by producing high amounts of inhibiting substances such as nitric oxide. The interactions of the various bacterial groups need to be better understood.

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