NEWBIES

Ammonia, from waste to commodity

Nitrogen Extraction from Waste By an Innovative Electrochemical System

74 % nitrogen in waste removed

15.5 kWh saved per kg N removed*

*compared to conventional nitrification/denitrification + HB

600 gN recovered per m^2 membrane per day

Shortcutting the nitrogen cycle

Our society relies on the application of fertilizer to ensure sufficient crop yield for food production. The production of nitrogen based ammonia fertilizers is responsible for about 1 to 2% of the worldwide energy consumption.

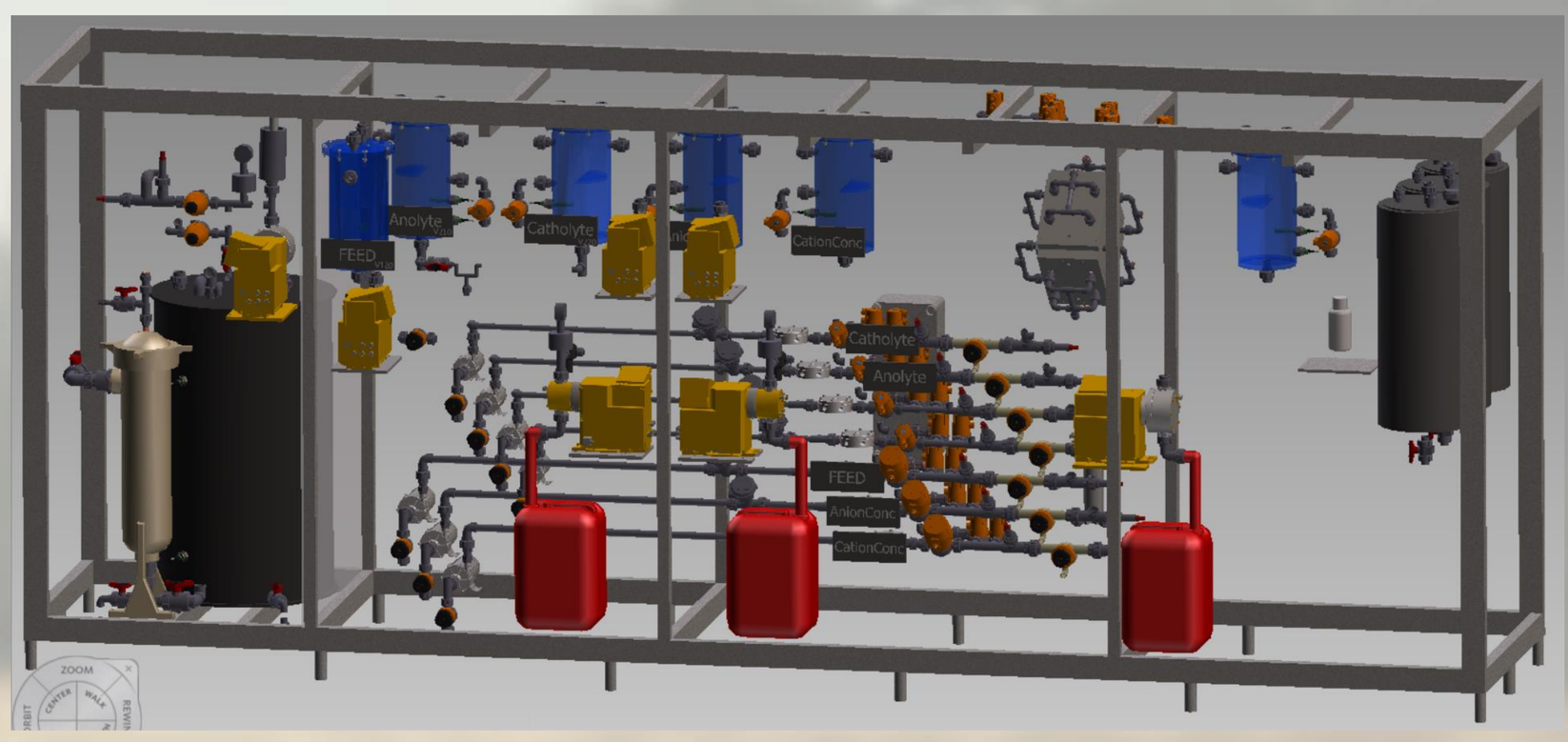
A large amount of this reactive nitrogen ends up in the wastewater we produce and needs to be removed to protect sensitive water bodies and to comply with current regulation.

Common practices for nitrogen removal from wastewater are energy intensive and convert reactive nitrogen to inert nitrogen gas (N_2). The production of nitrogen based fertilizers and nitrogen removal from wastewater are thus essential parts of the nitrogen cycle.

The LIFE-NEWBIES project aims to shorten the nitrogen cycle by directly recovering nitrogen (ammonia, NH_3) from wastewater using a combination of electrodialysis (ED) and gas permeation.

Earlier lab scale studies on this process to treat urine showed an effluent with a lowered TAN (total ammonia nitrogen) concentration and a product with potential use as a fertilizer (ammonium sulphate, see figure 1). Achieving a removal rate of 149 gN m^{-2} d^{-1} and recovery of 74% at a low energy input of 4.2 kWh kgN^{-1}, the energy demand associated with nitrogen removal and production was substantially lower than using conventional methods*

*More details published as: Kuntke, P. et al., *ACS Sustain. Chem. Eng.* **6**, 7638–7644 (2018)



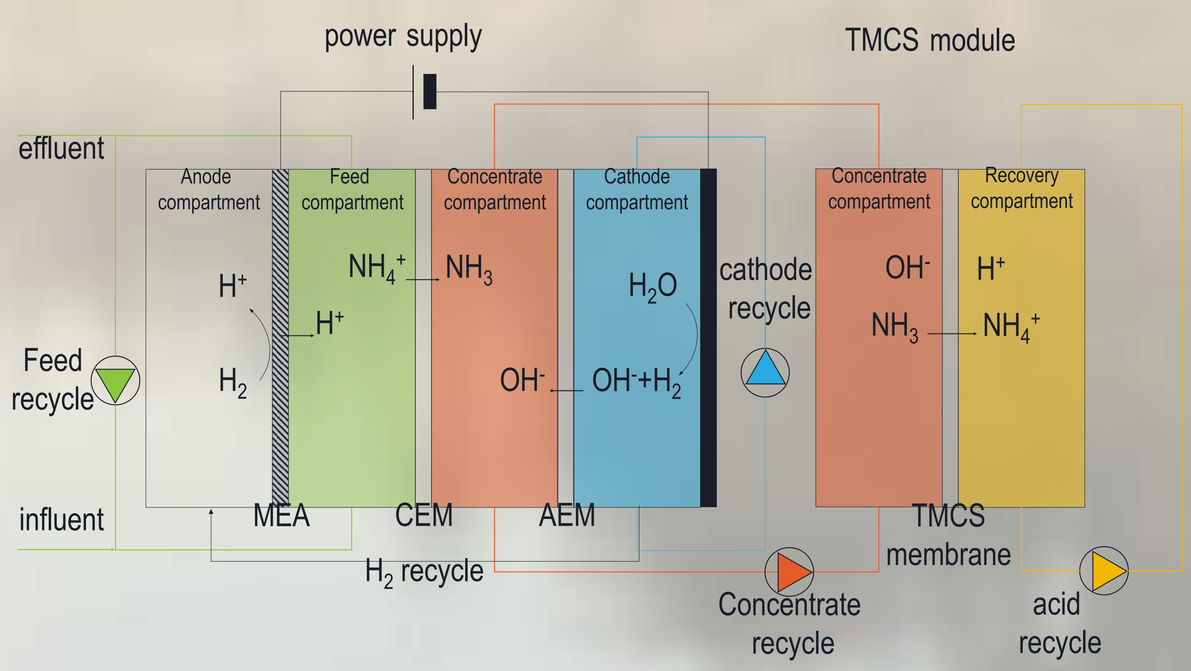


Figure 2, upper: 3D render of the designed pilot installation, with the ED stack and gas permeation module being the technologies core components.

Figure 1, left: schematic representation of the lab-scale system previously tested on source separated urine, providing the basis upon which the pilot installation was further designed.

Up-scaled pilot installation

The NEWBIES project aims to further upscale the technology as developed so far in the lab, and bring it into application using a selection of real waste waters, under real-life conditions. To this end, a containerized pilot installation has been designed consisting of a modified electrodialysis stack for ammonia removal from the wastewater and a gas permeable hydrophobic membrane module for subsequent ammonia recovery at its core (Figure 2).

Starting its operation in July 2019, this pilot installation will be run on digestate, source separated urine and landfill leachate, respectively. The pilot phase objectives are to:

- recover 1 kg nitrogen per day
- show NH_3 recovery at equal or lower costs, and with a lower environmental burden than conventional technologies
- produce a useful fertilizer product
- bind stakeholders for market uptake

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Started in July 2018, for three years the pilot project will further test the concept, and enable market entry

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A pilot installation will be operated on three waste waters, each for a consecutive period of 9 months, during which the installation aims to remove nitrogen at a rate of 1kg N per day

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