Adaptation of activated sludge biomass for nitrification of concentrated urine

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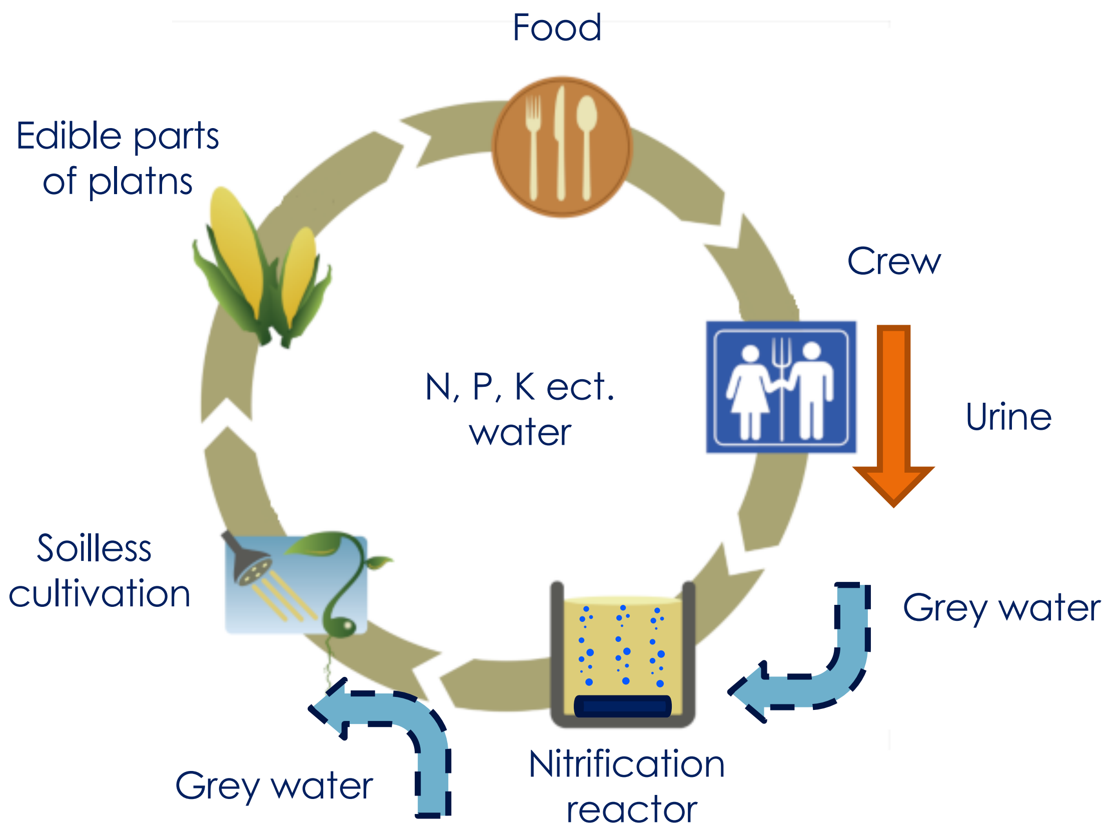
Background

- Part of PhD Thesis research titled: *The nitrification process and soilless cultivation of plants, as essential part of closed loop of elements and water in space systems.*
- Study on the effect of grey water dosage locations on other subsystems, nutrient solution production, plants growth and reactor operation.
- One of the essential steps: start-up of urine nitrification.



Urine nitrification

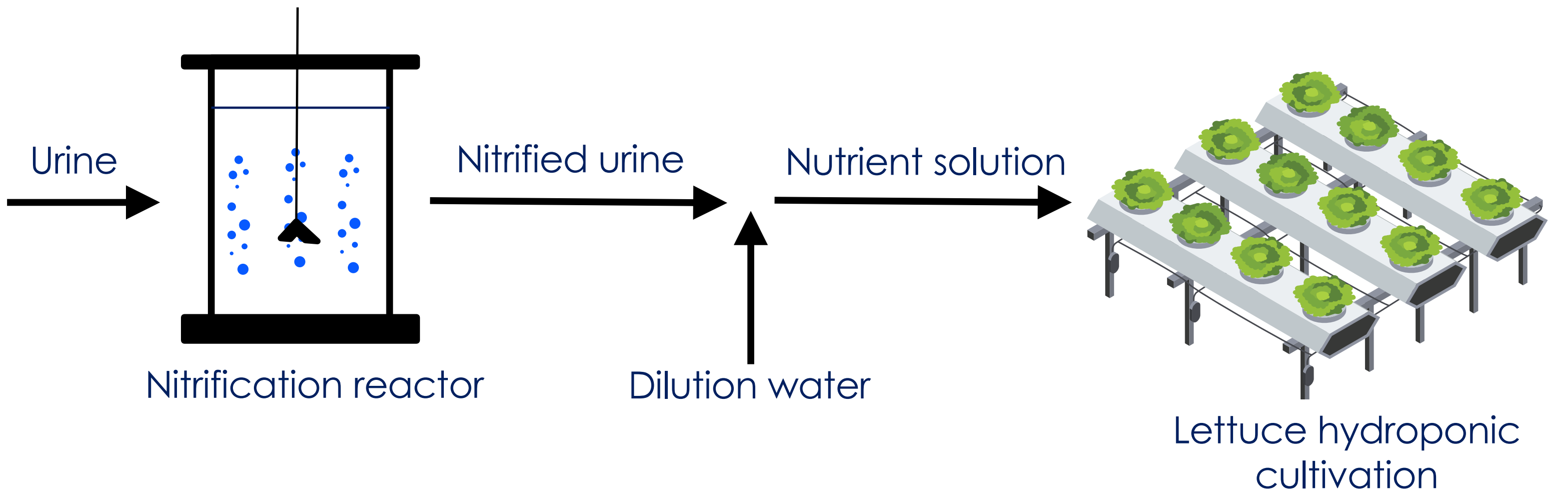


Figure 1. Scheme of the tested system.

Urine loading rate:
1-7 crewmembers

Flow based on
Anderson et al. (2018)

Composition based on
Feng and Wu (2006)

Operation parameters

Figure 2. SBR reactor used in the experiment.

Table 1. Basic operation parameters set in the reactor.

Parameter	Value	Unit
Oxygen concentration	3.0 set-point	g O_2/m^3
pH	Initially 6.6 – 7.0 set-point. After 55 days lowered gradually to 5.5.	-
Sludge retention time	>100	d
Temperature	30 set-point	°C

Operation parameters

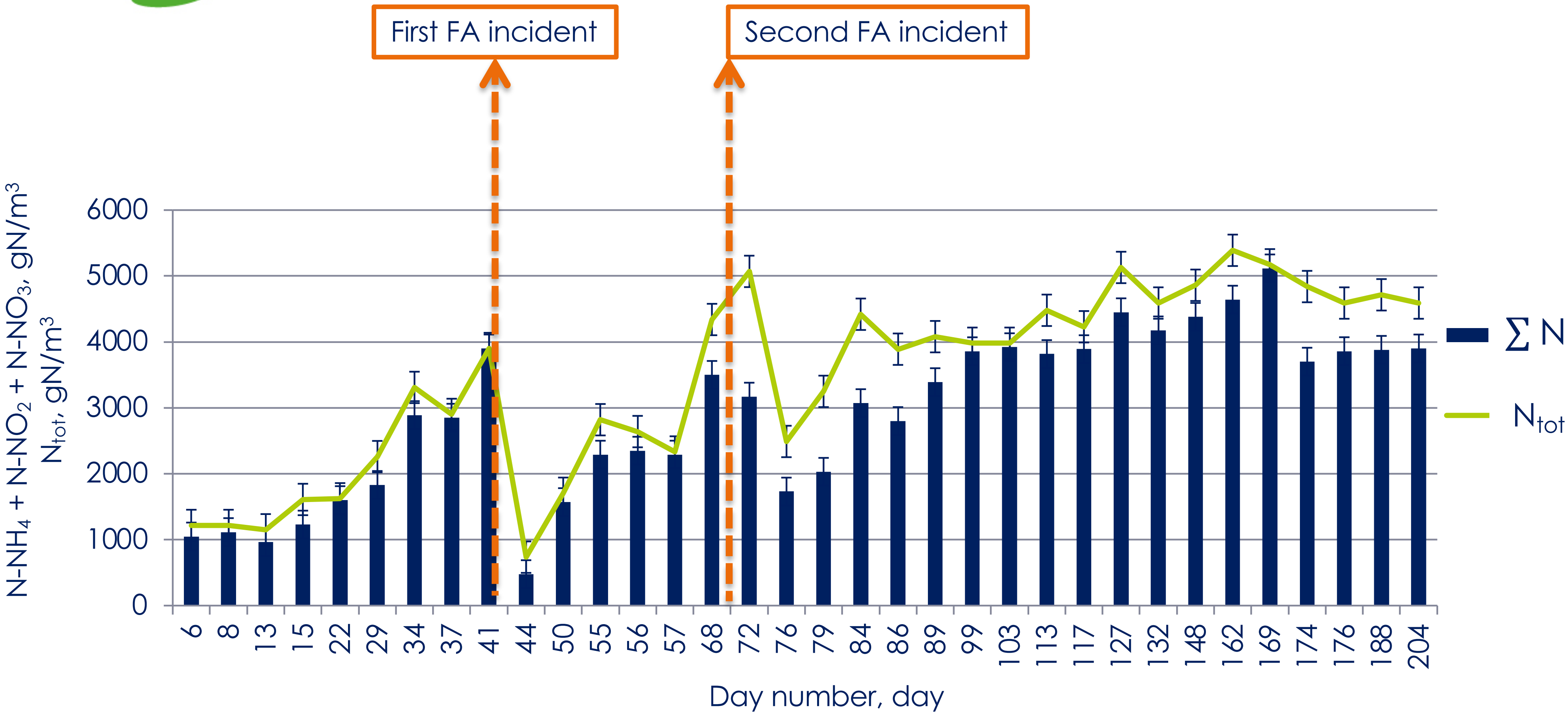


Figure 3. Comparison of all forms of nitrogen to total nitrogen in treated wastewater.

Salinity impact

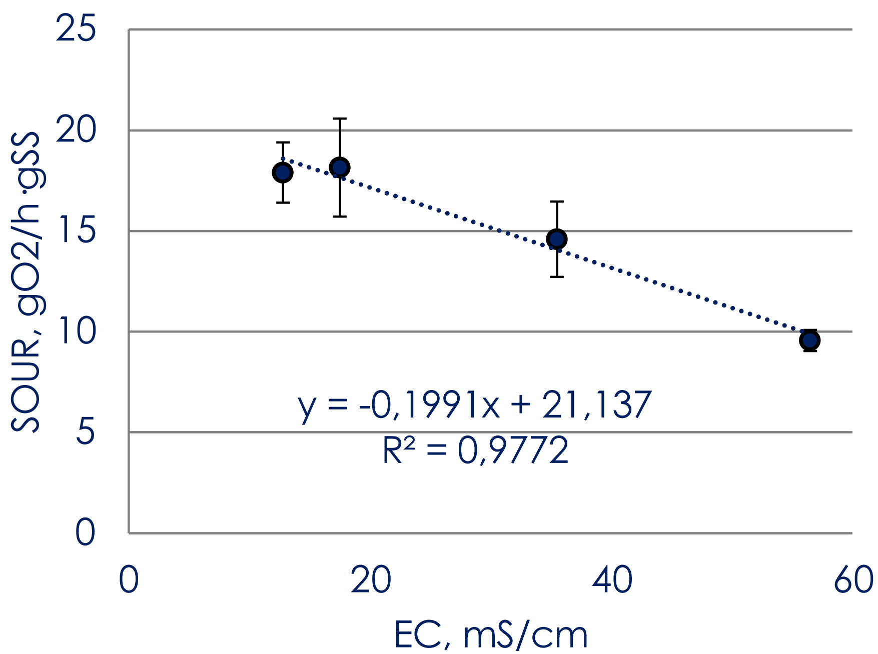


Figure 4. Specific Oxygen Uptake Rates (SOUR) course depending on the medium salinity (measured as electrical conductivity (EC)).

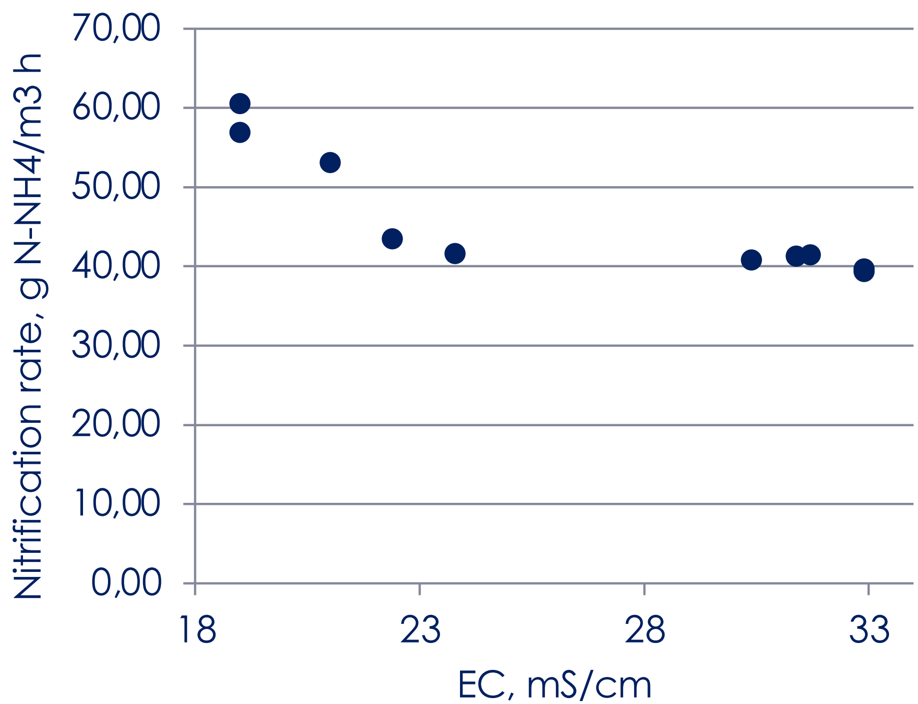


Figure 5. Relationship between the nitrification rate and EC during the second FA incident.

First FA incident

T=19 h, pH 8.80,
NH_4-N: 807 gN/m^3,
FA: 280 gN/m^3

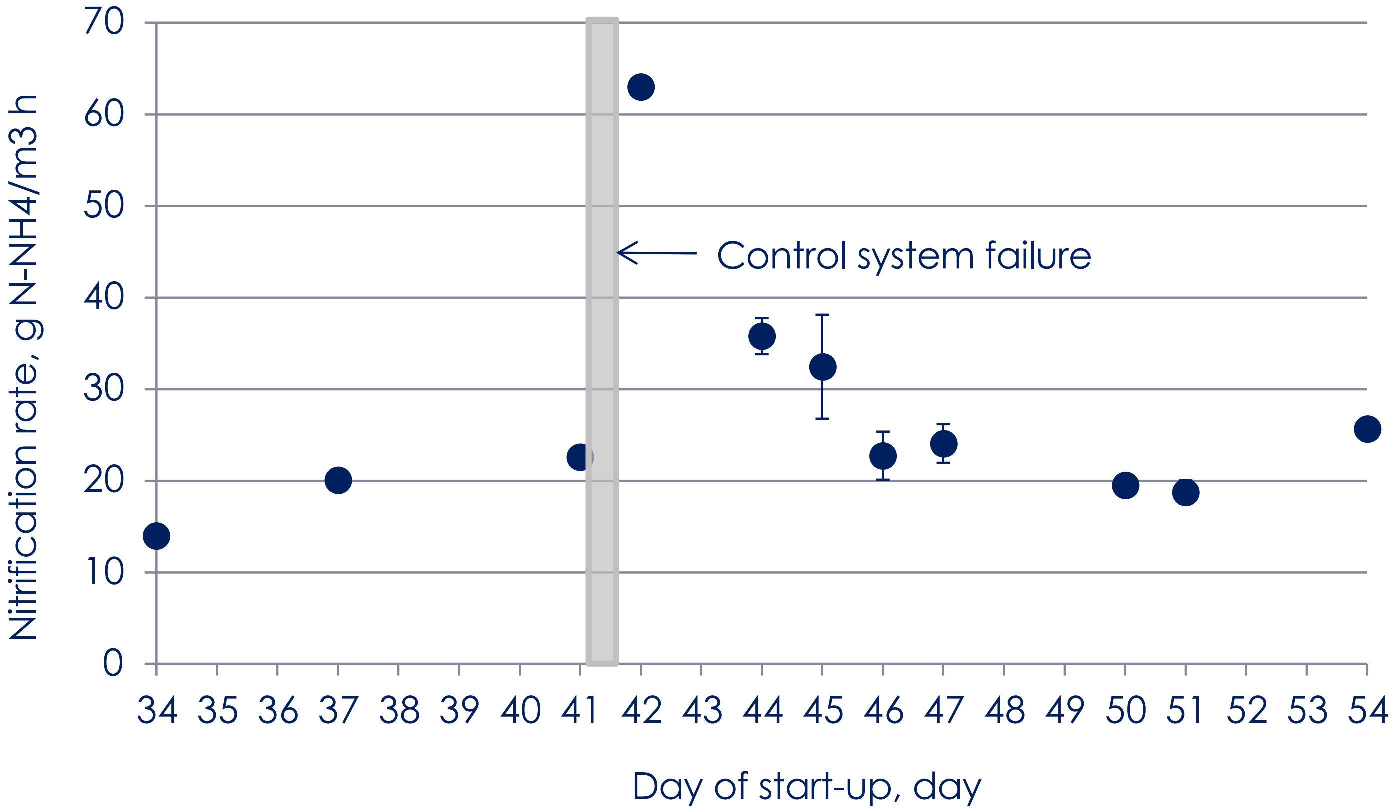


Figure 5. Nitrification rate before and after the first free ammonia incident..

Second FA incident

T=27 h, pH 8.19,
NH4-N: 756 gN/m3,
FA: 84 gN/m3

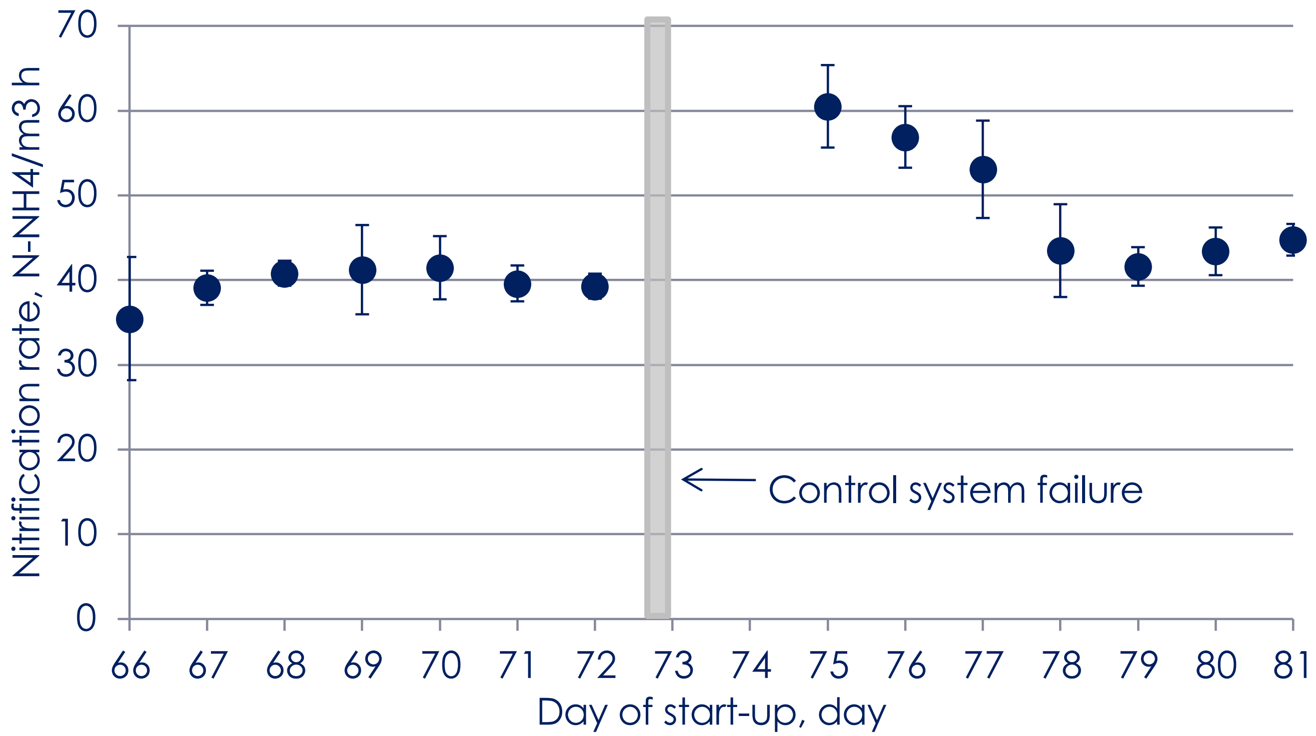


Figure 6. Nitrification rate before and after the first free ammonia incident..

Summary

- Salinity was the main limiting factor concerning nitrification efficiency. Dilution and a decrease in salinity led to a considerable increase in the nitrification rate.
- Despite prolonged exposure to a very high FA concentration (19 hours exposure to FA concentrations of 280 g $N\text{-}NH_3/m^3$, and 27 hours exposure to 84 g $N\text{-}NH_3/m^3$), only temporary inhibition of nitrifiers occurred.
- It was possible to restore nitrification with simple remedy actions such as decantation, dilution and the restoration of the proper pH.

Nitrified urine as fertilizer

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THANK YOU.

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