Day 3 - Thursday Nov. 4

Chat Conversation

Lifecycle Assessments & Environmental Impacts

Moderator: Ivan

Presenters:

Valentin Faust

N2O emissions and carbon footprint of a urine treatment and fertilizer production system

- From Rich Earth: Valentin, does this mean that EAWAG is moving toward going straight from the partial nitrification step to the carbon filtration and then straight to the distillation step? Great presentation!
    - Response from Valentin: You mean without intermediate storage? Yes, kind of. After the N2O measurement we reduced the intermediate storage between nitrification and GAC Filtration to one decant Volumen leading to volume of around 15L instead of 200L. We can do that, because the GAC is usually not the Bottleneck of the System. We did not change the intermediate storage between GAC and distillation because we did not see any N2O Formation after GAC.
- From Prithvi Simha: Valentin, Any comment on how the Vuna process will fare against the partial nitrification-anammox process that we heard about yesterday, in terms of the carbon footprint, as both are being tested by the Melissa project?
    - Response from Valentin: For MELiSSA both Project serve different objective: VUNA Treatment to recover nutrients for plant growth and PN/A to produce N2 for compensating pressure los. For space Habitation nutrient recovery will be the main target but for space stations (e.g. ISS) N2 production might be more important. To compare both processes for on-earth application, we will need N2O measurements from PN/A
- Comment From Richard Piluk: Valentin, Your approach should be applied to more biological treatment systems.
    - Response from Valentin: Thanks. Would also love to compare it to the N2O emissions with other biological Urine Treatment System such as full nitrification using Membrane aerated Biofilm reactor
        - From Richard: Valentin: Is the relationship between nitrous oxide and nitrites well known?
            - From Valentin: In a few N2O measurement campaigns from WWTP the positive correlation of N2O and nitrite was shown, which most likely is linked to the fact that nitrite is an intermediate of the N2O denitrification pathways. What is rather exceptional for our measurement camapign, is that we had a very high resolution for the nitrite thanks to a novel electrochemical nitrite sensor. Further, our System allows for nitrite Control using the pH Control strategy and the nitrite sensor (see Britschgi et al. 2020) and therefore allows us to mitigate the N2O emissions by keeping the nitrite concentration low. Nitrite Control in Mainstream WWTP is more difficult
                - From Richard: Valentin, What pH range did you try to control to keep nitrite levels low?
                    - From Valentin: pH during the measurement campaing range between 5.8 - 6.45. At pH above 6.3 we observed nitrite accumulation. But this is not a fix number. We also had cases in the past, where we operated the nitrification at pH 7 without nitrite accumulation and at pH 6 with nitrite accumulation. This is why, the nitrite sensor is so important

Dr. Nancy Love

<u>Life Cycle Assessment of Urine Diversion and Conversion to Fertilizer Products at the City Scale</u>

- Comment from Hayley Joeyll Smith: Sewershed! What a great term. Great presentation, Nancy.
- Comment from Shawn Shafner: Thanks Nancy! WOW! Gives me hope to think about the opportunities these increasing regulations could lead to. NYC…oooh Lala.
    - Response from Nancy: Yes, Shawn, NYC is coming around! A new research director who is familiar with our repeated presentations to the utility community became curious. Will definitely try to connect with you while our student Lucinda is there next winter.
- From Kai Udert: Nancy, based on this study, which features of urine treatment processes could be critical and could result in negative environmental impacts?
    - Response from Nancy: The energy for urine treatment methods can vary substantially. I have to check Stephen's Supplemental Info, but I think he used 9 or 10 Wh/L for RO, but some technologies have energy demands that are much larger than this and would not be as beneficial relative to conventional treatment. Also, the acidification associated with chemical use for ion exchange media regeneration was huge.
- From Prithvi Simha: Nancy: Thanks. Today we have quite a lot of evidence about the positive environmental effects of urine source separation. Why then do most cities and wastewater managers dismiss the idea - they are curious, they discuss it but end up dismissing it eventually (at least from our experience here in Sweden)? Would love to hear your thoughts on this.
    - Response from Nancy :i moving behavior and attitudes requires targeting the early adopter/innovators in the industry who the other industry members listen to. So, getting the visible technology innovators and implementers at the visible utilities to listen, consider, and talk about urine separation as a resource recovery approach makes others listen more. Motivation to move into an innovation space comes when people want to emulate the innovators. Happy to discuss further.
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Tristan Martin

<u>Human urine in agriculture: various management options contributing to sustainable nitrogen fertilization</u>

- From Kai Udert: Tristan, any idea how high the energy demand is compared to the overall energy demand for growing the wheat? Is the contribution relevant compared to, e.g., the fuel needed for the tractors?
    - Response from Tristan: In term of primary energy the energy needed for the treatment was the main contributor. The energy for fuel consumption is included in the "other operation" category but it is lower.
        - From Kai: Thank you, Tristan. I might not have expressed me correctly. I was wondering, whether you have any information for the overall energy demand for growing 1 kg wheat. That means the Costs for preparing the soil, harvesting etc.
- From Valentin: For nitrified concentrated urine, you assumed an N2O EF of 0.5% in your PhD thesis. What was the scientific rational behind choosing this number?
    - Response from Tristan: As there was no data at that time we take the emission factor for classical activated sludge treatment in WWTP
- From Abe Noe-Hays: Tristan, how did you select the NH3 volatilization rates for the different fertilizers, particularly the direct application of stored urine?
    - Answered Live
- From Fernando Perez: Tristan, thanks for your presentation! urine is not very high in phosphorus concentration. how did you balance the P requirement from wheat in the scenarios with urine-based fertilization?
    - Answered Live

Umakant Badeti

<u>Impact of source-separation of urine on effluent quality, energy consumption and greenhouse gas emissions of a decentralized wastewater treatment plant</u>

- From Nancy: Umakanth, excited about your new grant! Would definitely like to learn more.
    - From Sherub Phuntsho: Just to clarify, Umakant was referring to the NiCE project led by

Shon. You are one of he PIs.
    - From Nancy: Ahhh!!! Even better!
        - From Sherub Phuntsho: Nice to meet you Nancy. See in NiCE project. :)
        - From Umakanth: Thank you Prof. Nancy Love, nice to meet you and happy to know that you are one of the PIs in this project.
- From Michel Riechmann: Umakanth, thanks for your presentation! Did you also calculate the additional investment costs for urine diversion and treatment and the connected impacts?
    - From Umakanth: Michel, this study did not calculate the investment cost for urine diversion and treatment. But these are some of our future objectives.