

Nitrogen recovery by membranes

**ESPP, Nitrogen recovery &
recycling**
19th Jan, 2023
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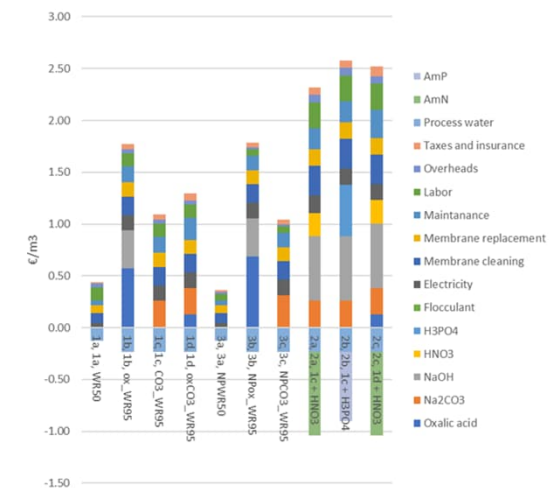
16/01/2023 VTT – beyond the obvious

Background to nitrogen recovery by membranes



Industrial liquid side streams in TYPKI project

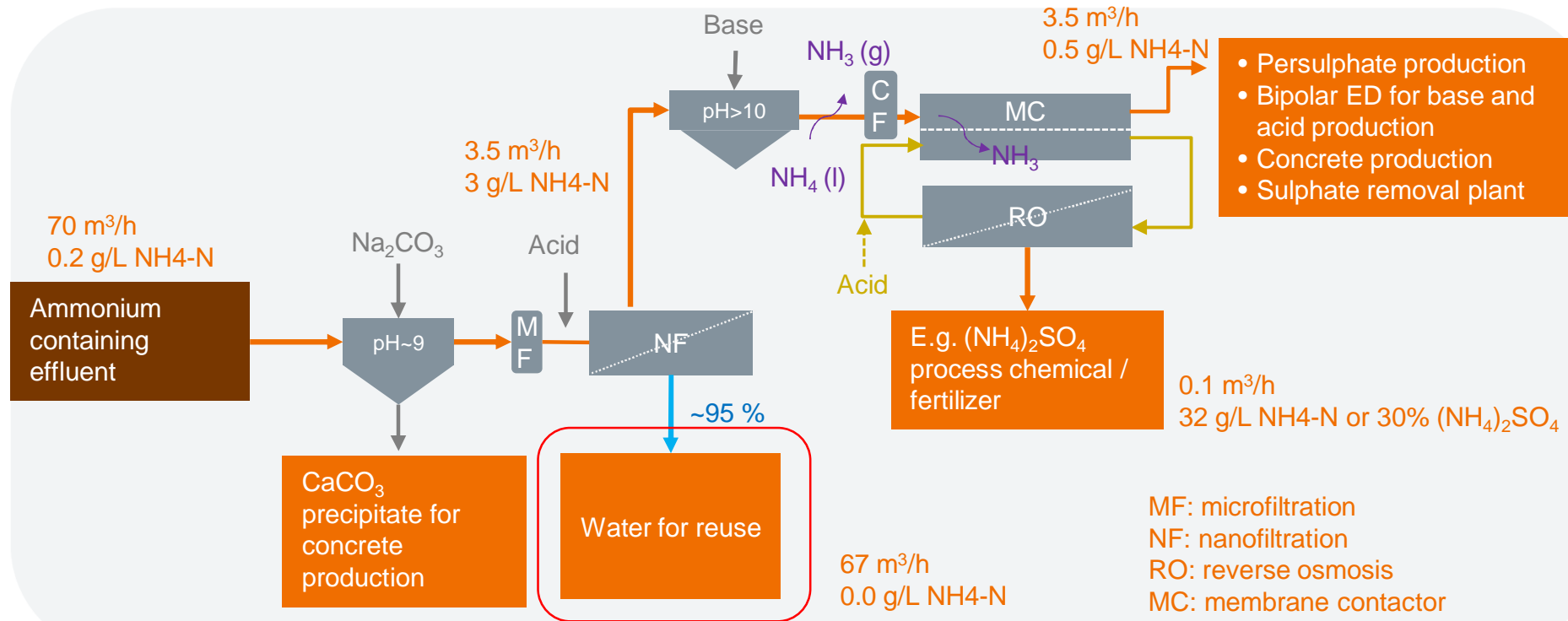
- Industrial waters are often in large volumes and low solute concentrations
- Nitrogen (N) concentration and recovery from liquid stream is the most feasible if it is a part of water purification
 - Concentrate needs to be deposited, thus nutrient recovery is a good option
- Recovery usually requires many steps when targeting to pure and sufficiently concentrated circular economy product
 - As deposition of impurities is costly, low volume matters
→ makes concentration and recovery more desirable
 - Foulant/scalant removal is needed for membrane concentration
 - Final concentration requires often additional technologies
 - If many steps are needed, recovery becomes easily costly
 - All streams need to be considered
- Potential of flue gases in N recovery is not well exploited



Techno-economic analysis

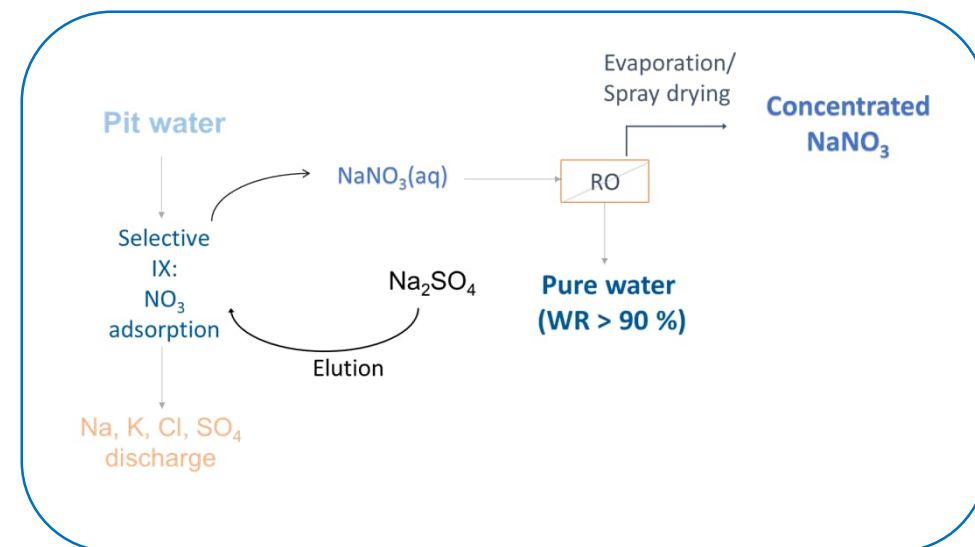
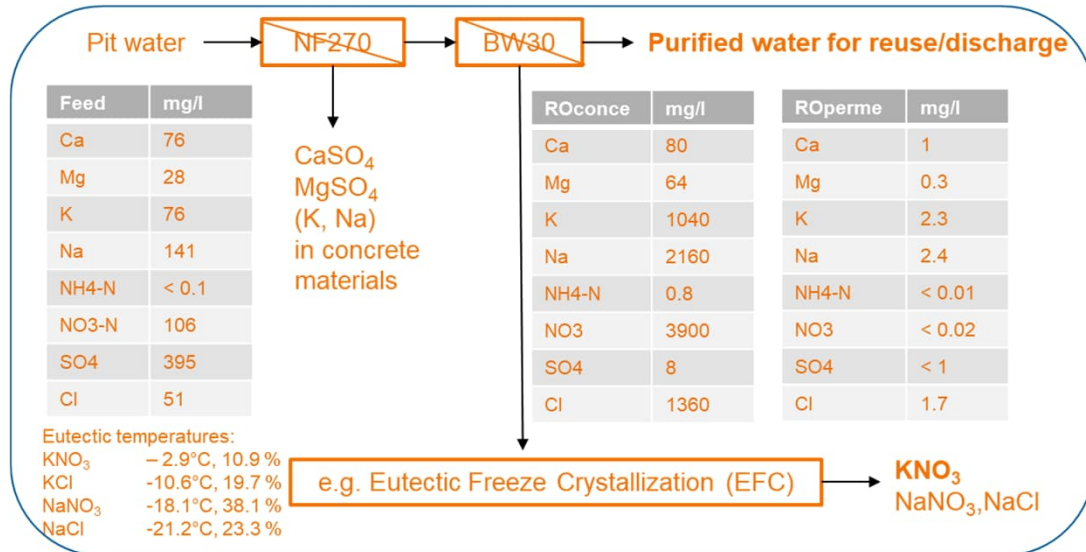
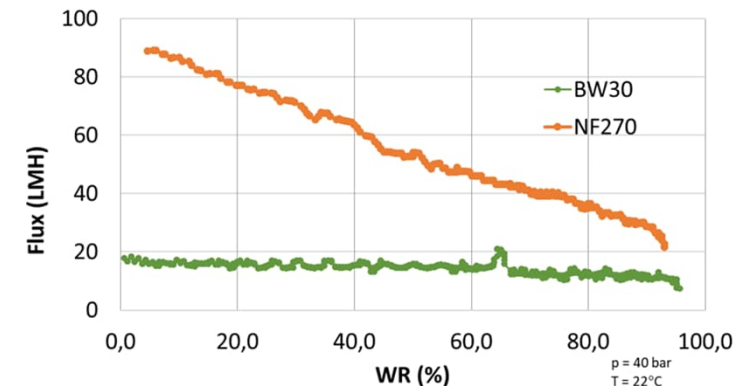
Ammonium from a mine effluent

- Goal: Minimise surface water intake, decrease the volume of N in liquid
- TYPKI result: Purified water by membranes, 20-times decrease of volume of N containing water, reuse options for impurities/nutrients



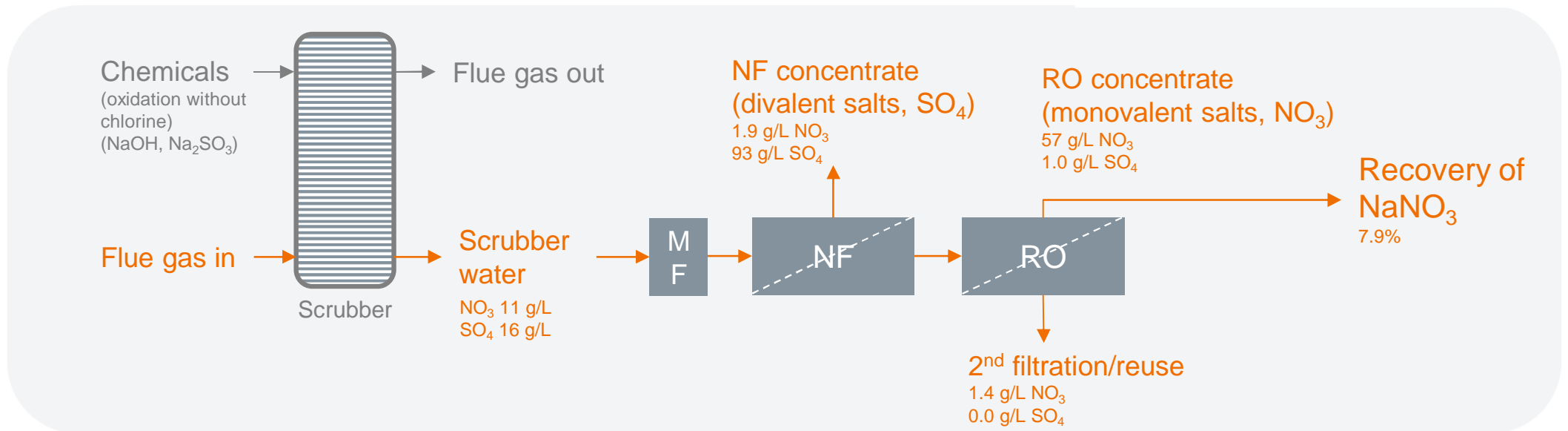
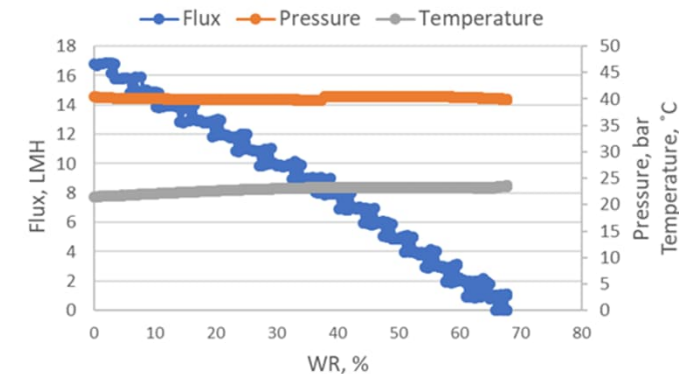
Nitrate from explosive residues in water

- Goal: Decrease the content of nitrate in discharge/reuse water, nitrate concentrate for usage
- TYPKI result: 95% purified water with low impurity content, defined concepts for nitrates



Nitrate from NO_x scrubber water

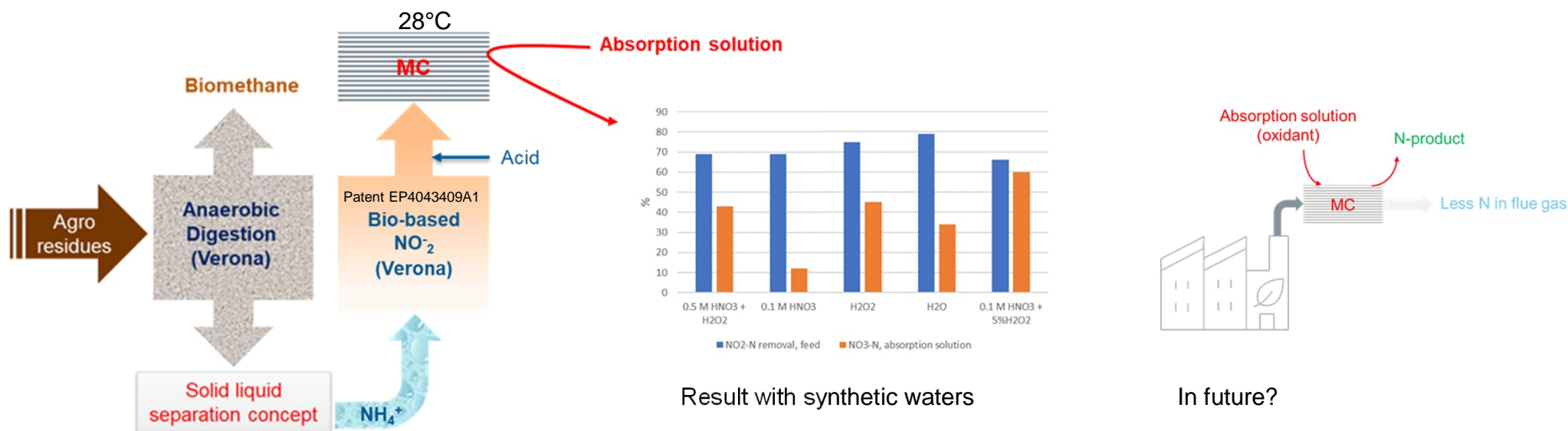
- Goal: Minimise discharges, increase the concentration of nitrate for usage
- TYPKI result with synthetic water: 87% rejection of nitrate in purified water with 1-pass RO, 5-times concentrated nitrate having 16-times less sulphate



N-products from biogas production

Cooperation with University of Verona/Prof. Nicola Frison

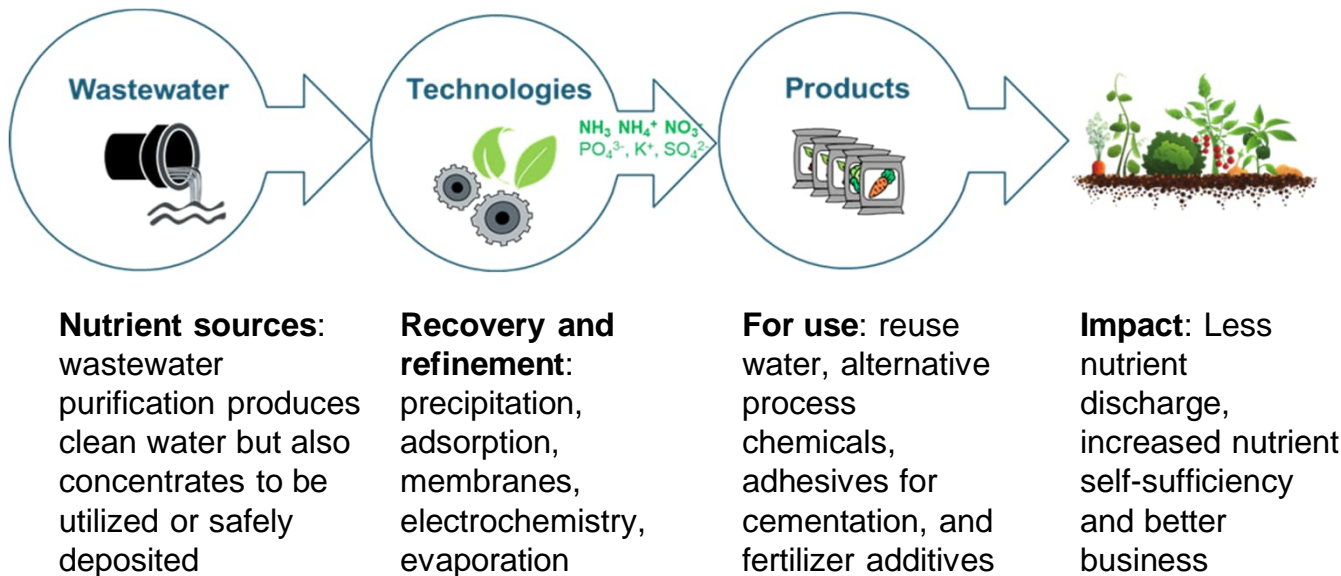
- Goal: Removal of fine suspended solids (SS) as a pre-treatment, recovery of N as nitrate from reject water using less chemicals
- Result so far: Ammonium has been biologically converted to nitrite which is chemically vaporized to NO_x gas and absorbed in oxidizing solution



TYPKI - Resource-wise nutrient recovery from industrial wastewater

At VTT we develop feasible solutions for treatment of industrial wastewater and recovery of nutrients hence answering the challenge of ZLD.

The on-going **TYPKI project coordinated by VTT promotes recovery and refinement concepts of nutrients into industrial chemicals, construction materials, and fertilizer additives.**



Schedule: Feb 2021-Jan 2023

Budget: EUR 1.03 million

Financer: Business Finland and the participants

Participants: VTT, University of Oulu, Tapojärvi, Aquaminerals, BioSO4, Brightplus, Industrial Water, Agnico Eagle, Gasum, Hannukainen Mining, Valmet, Yara Suomi



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the obvious

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