CETAQUA
WATER TECHNOLOGY CENTRE

CHANIA 2023

Smart fertiliser production from nitrogen recovery process

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1. Introduction. What is a biofactory?

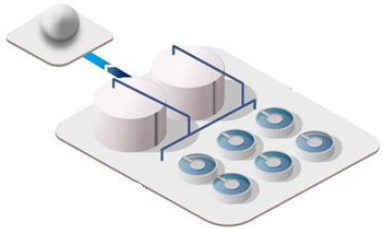
WWTP → Biofactory

Wastewater as a waste

High energy consumption

High greenhouse emissions

Unavailable resources



Wastewater as a resource.

Low energy consumption.

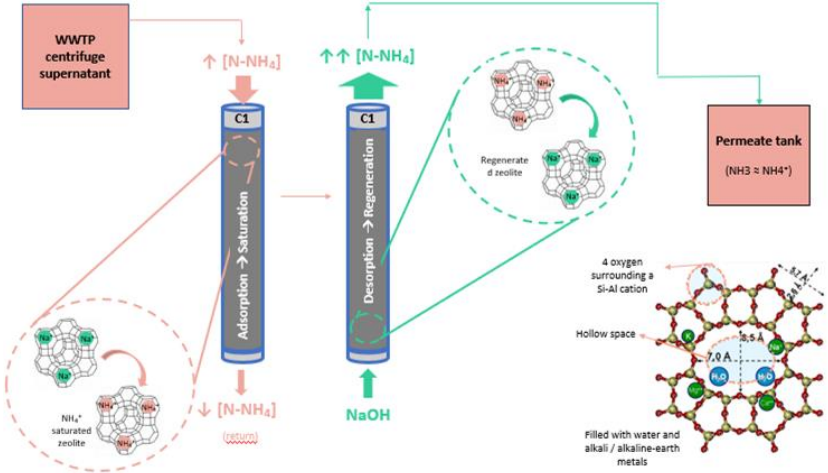
Descarbonization and green energy.

Resource recovery

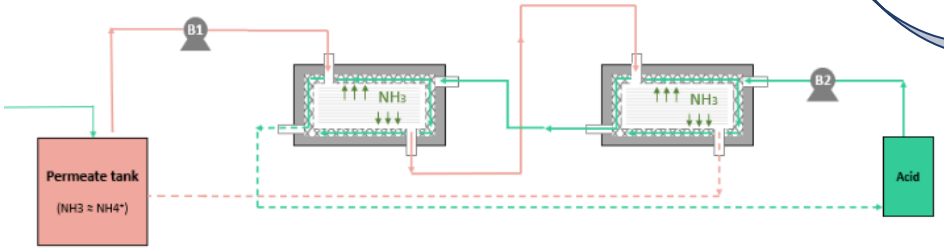
New and circular business models

2.Set-up. Smart BBF production

1. Cation exchange for N concentration



2. HFMC for NH_4^+-based salts

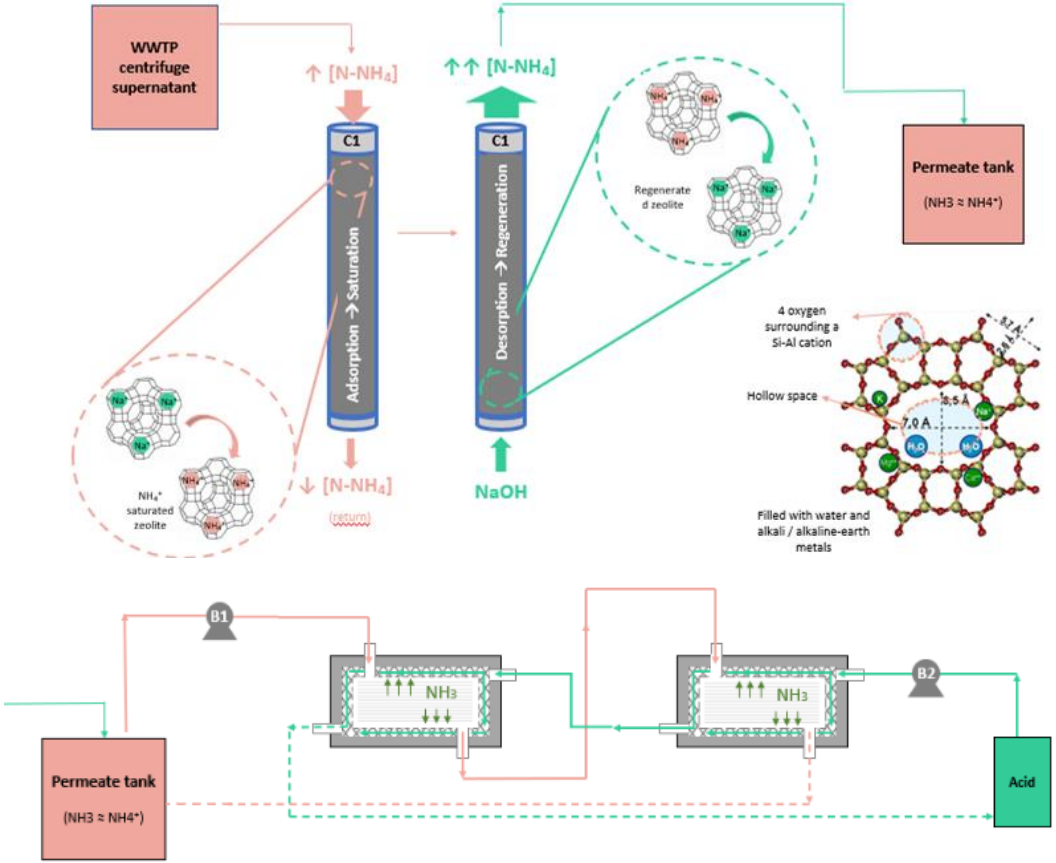


3. Smart BBF production

- Ammonia salt
- Struvite
- PGPB

The aim of this work is to produce a NP Smart BBF

2. Set-up. Nitrogen recovery treatment train



- Anaerobic digestion supernatant as feedstock.
- Filtration unit, to remove the possible solids.
- Ion-exchange unit with natural zeolites for nitrogen concentration.
- HFMC for nitrogen recovery (2 units of 2.5x8 Liqui-Cel).

3.Results

1. Cation exchange for N concentration

- Use of zeolite as a cation exchange (CE) surface to retain NH_4^+ from rejected water from WWTP.
- HRT below 14 min radically compromise de CEC of zeolite.
- HRT of 14 min was established as optimal.

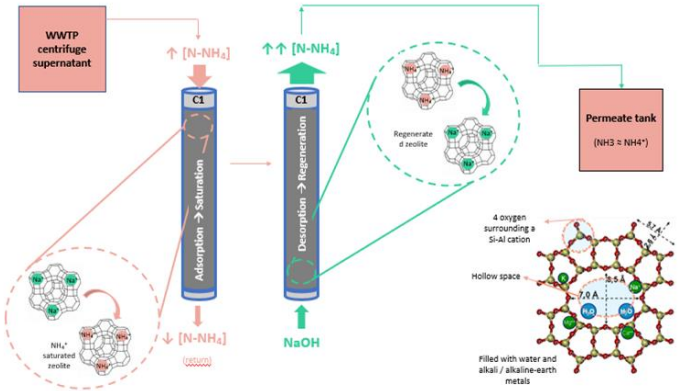


Figure 1. CE set-up for N concentration.

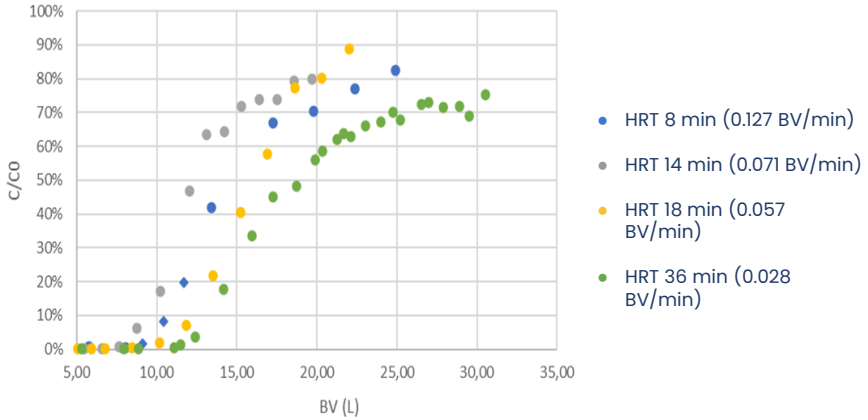


Figure 2. Operational flow rate tested in duplicate.

HRT (min)	Average CEC (g NH_4^+-N /g zeolite)
8	8.60
14	13.70
18	12.81
38	13.47

3.Results

1. Cation exchange for N concentration

- Recovery of a N concentrate permeate with NaOH solution as regenerant being 0.35M the optimum condition.
- Depletion of CEC was observed during the experimentation

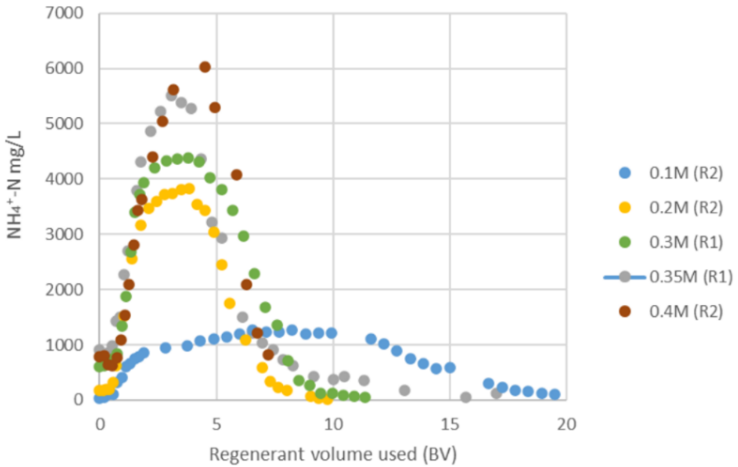


Figure 3. Regenerant concentration determination.

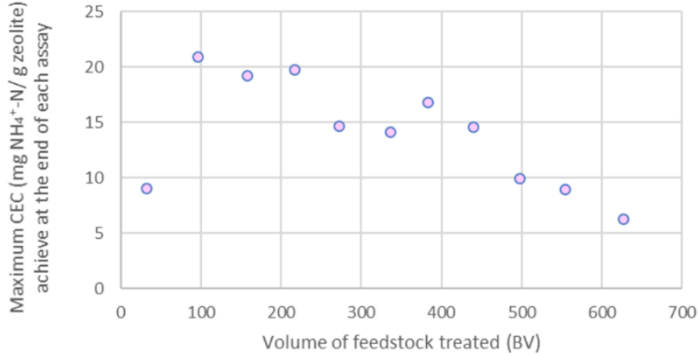


Figure 4. Maximum CEC achieved per consecutive assay.

3.Results

2. HFMC for NH_4^+ -based salts

- No differences were observed when flow rate increase over 400 mL/min.
- Acid flow rate variation didn't affect the recovery rate or efficiency either.
- Sulphuric acid 0.35M as acid solution
- Final ammonia sulphate solution concentration was around 8% N
- 99% of recovery efficiency was achieved

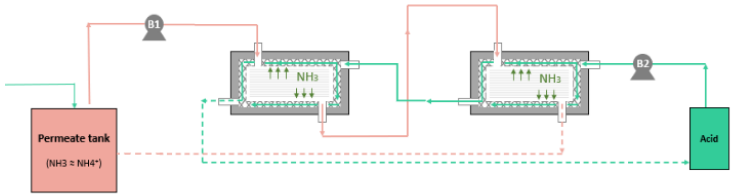


Figure 5. HFMC set-up.

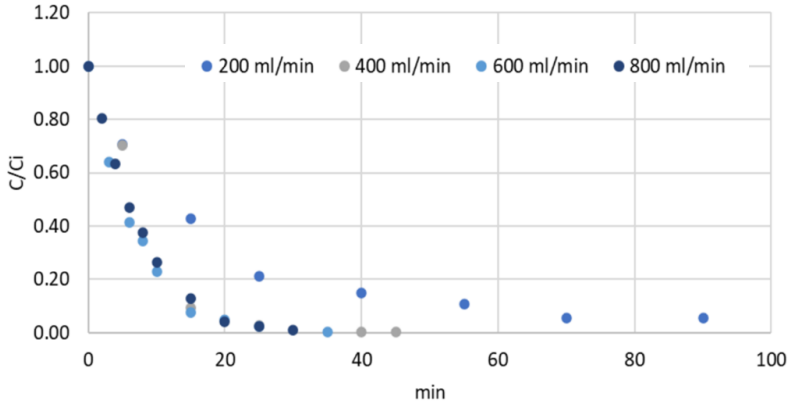


Figure 6. Feed flow rate effect.

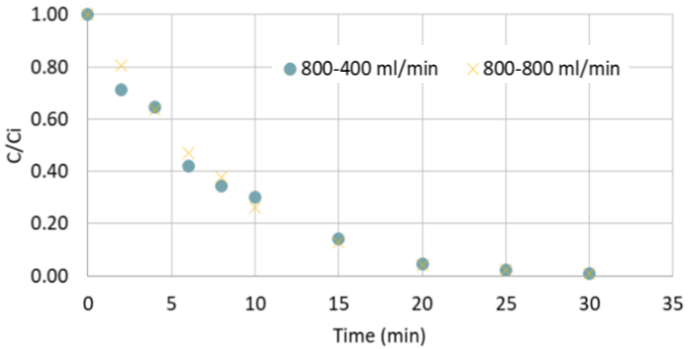


Figure 7. Acid flow rate effect.

3.Results

3. Smart BBF production

- It is an ongoing task
- The recipe is defined in terms of struvite and ammonia salt content as well as PGPB.
- 4 bacteria strains were selected: *Pseudomonas putida*, *Bacillus megaterium*, A*zospirillum brasilense* and *Pseudomonas aeruginosa*.
- Pot and field tests are going to be performed.
- It is necessary to add a culture medium to the fertiliser to allow bacteria to grow (LB).

4.Next steps- scale up

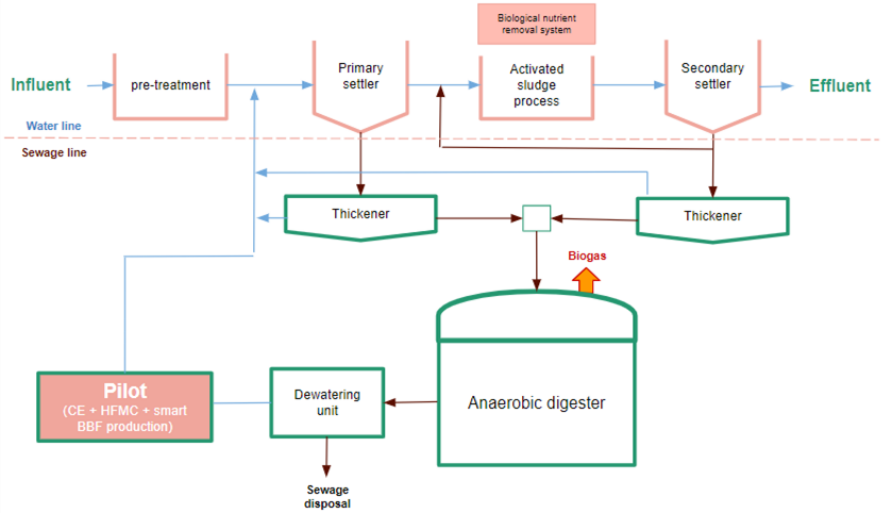


Figure 9. Location of the WWTP where the pilot plant will be installed.

Figure 8. Ourense's WWTP (VIAQUA).

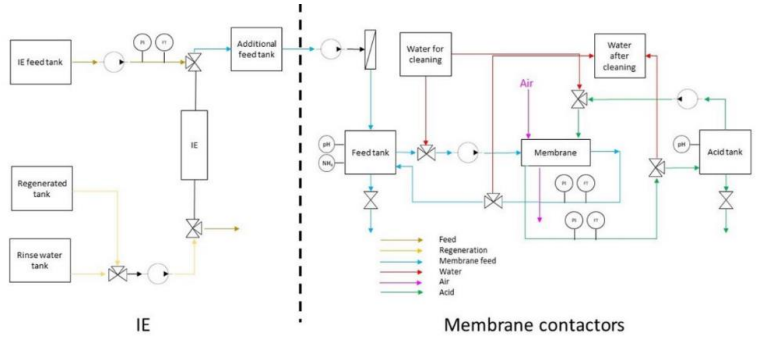
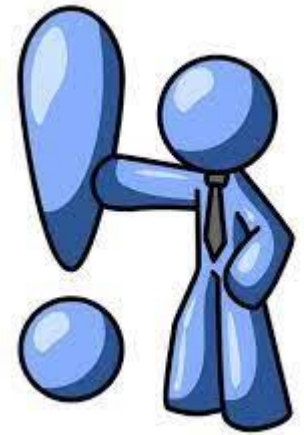


Figure 10. Pilot plant layout.

5. Take home messages

- Treatment train is capable to recover nitrogen from anaerobic digestion supernatant with a high recovery efficiency
- The optimum conditions have been defined at lab scale in terms of flow rates, NaOH concentration or acid concentration.
- The Smart BBF recipe is defined and the PGPB selected
- Next steps are defined in terms of:
  - Scale-up
  - Pot and field trials of the fertiliser



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Thank you!

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The authors are grateful to the Axencia Galega de Innovación through FEDER Galicia 2021-2027 (IN853C2022/03).

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