

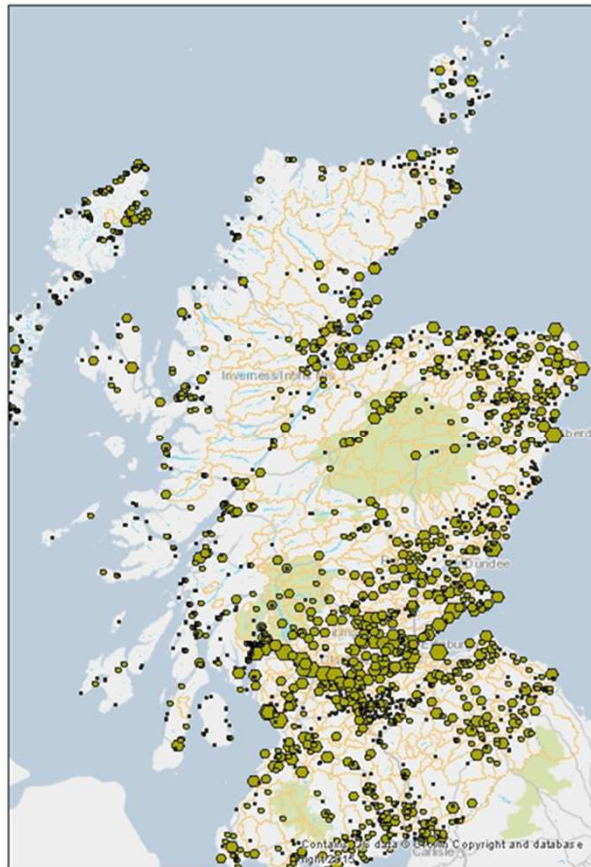


Microalgae as a solution for wastewater treatment: knowledge gained from operation at sewage works

Phos4You final conference, Essen & online, 22 – 23 September 2021

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Wastewater treatment in Scotland



Capacity (PE)

- 0 – 50
- 51 – 500
- 501 – 5000
- 5001 – 50 000
- 50 001 – 150 000
- > 150 000

- 97% rural
- 1600 WWTPs capacity <500PE

- Implementing P recovery technologies in small-scale WWTPs faces several challenges:
 - P concentrations are lower than compared to large WWTPs
 - Remote accessibility, hence maintenance, robustness and operation constrains.
 - High variability in both flows and P concentrations

Microalgae technology: *Chlamydomonas acidophila*

- Unicellular green algae
- It grows at pH values between 2 – 3
- It accumulates high concentrations of **lutein (antioxidant)**



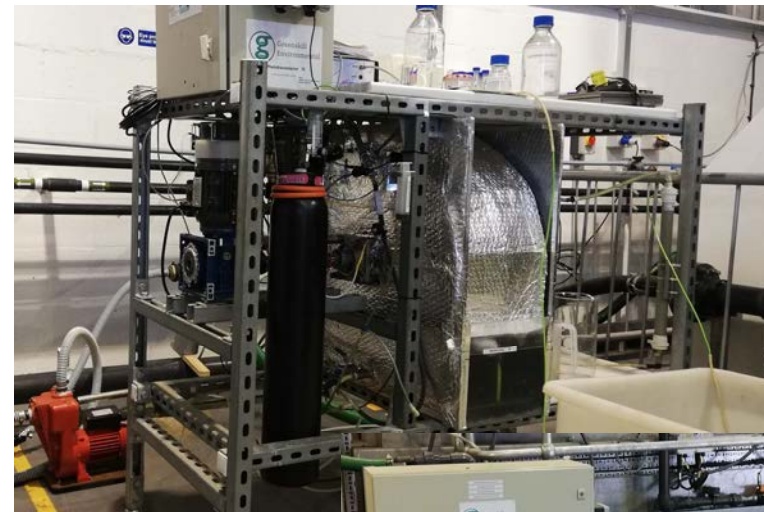
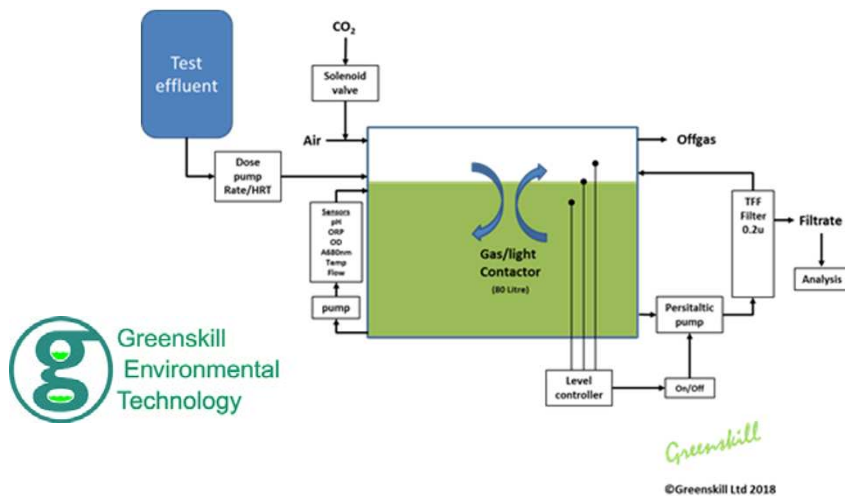
Low Light
intensity

Mixotrophic
Fix C from inorg and
org sources

Very resistant

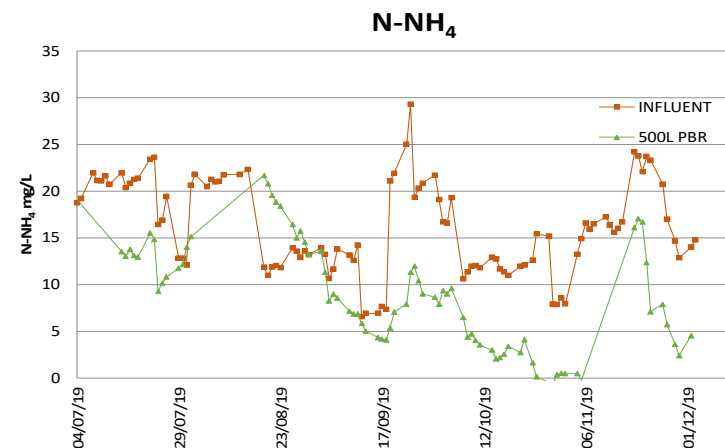
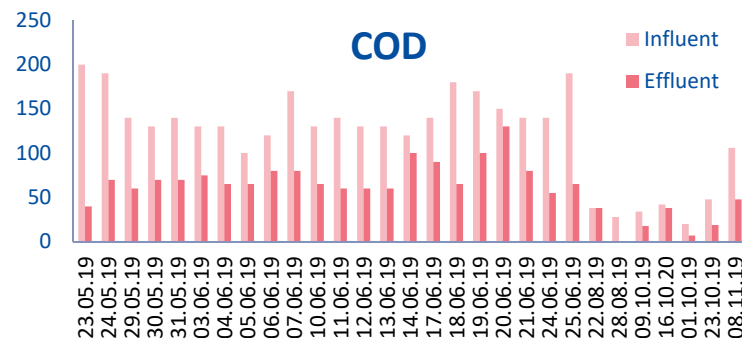
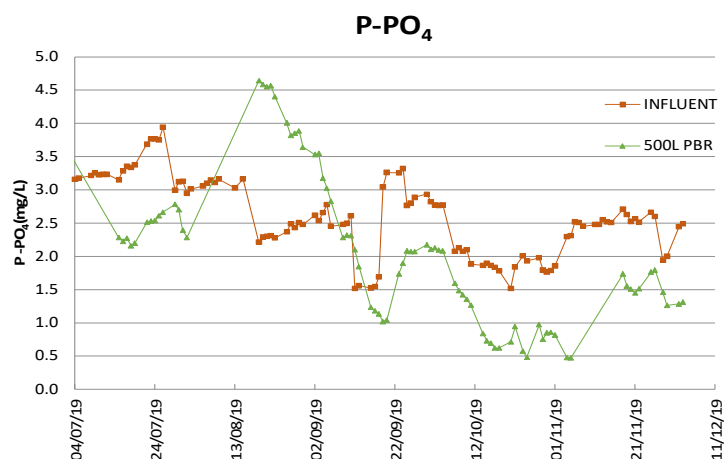
- Pharmaceuticals
- NH_4^+





- *Chlamydomonas acidophila* (pH 2-3)
- 75L and 500 L suspended cells PBR
- Treating effluent from primary sedimentation
- 6 months
- No aeration required
- Incorporates LED lighting and heat exchanger
- Biomass retention: TFF

P-recovery process results



RESULTS

- Recoveries/removals from primary effluent:
 - 50-75% PO₄
 - 75-100% NH₄
 - 50% COD
- ROBUST → maintained long term as mono-algal culture
- Easy to separate using tangential flow filtration → it did not foam or exhibit biofilm formation in the PBR
- This technology seems to be suitable as a secondary/tertiary treatment of wastewater for small WWTPs

Recovered product: microalgae biomass



4 g/L
[µalgae biomass]
in the photobioreactor



+ 0.5 g NaOH/L
Sedimentation



4-6 % TS
Liquid separation



90 % TS
Drying

Recovered product: microalgae biomass

Phos4You preliminary results

Quality assessment team (UGhent, INRAe, ERI, HVC, GCU)

- Corg. >15%
- TN = 6.2 %dm
- P₂O₅ = 1.9 %dm
- Secondary macronutrients (MgO, CaO >1.5%) and specifically high Mg: P ratio
- contaminants, pathogens and persistent organic pollutants tested are lower than the limits defined in EU FPR 2019
 - Cu ~ 520 mg kg⁻¹. Limits:
 - PFC1 (A) Org fert: 300 mg kg⁻¹
 - PFC1 (B) Org Min fert: 600 mg kg⁻¹
 - PFC3 (A) Org soil improver: 300 mg kg⁻¹
 - PFC6 (A) Plant stimulant: 600 mg kg⁻¹



Conclusions

***Chlamydomonas acidophila* microalgae technology seems to be suitable for small WWTPs:**

- robust (no foaming or biofilm formation)
- can be maintained long term as a mono-algal culture
- can recover P and N from WW with high variability of nutrients
- requires low light intensities to grow and consume nutrients
- produces microalgae biomass that could be distributed locally to support circular economy

