Microalgae cultivation as a tertiary treatment step in urban wastewater treatment plants

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Introduction and Aim

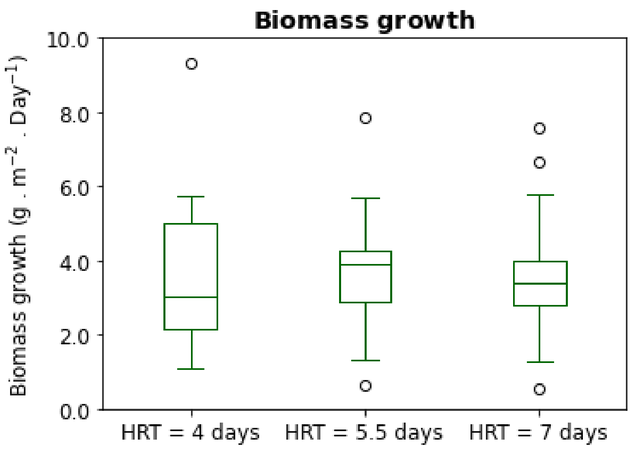
The revised urban wastewater treatment directive demands tertiary treatment for plants treating 150.000 p.e. or above. Microalgae cultivation shows great promise for this purpose, allowing not only to remove but also to recover N and P, contributing to the circular economy. The aim of this work is to optimize the hydraulic retention time (HRT) in microalgae-based processes to recover nutrients from urban wastewaters.

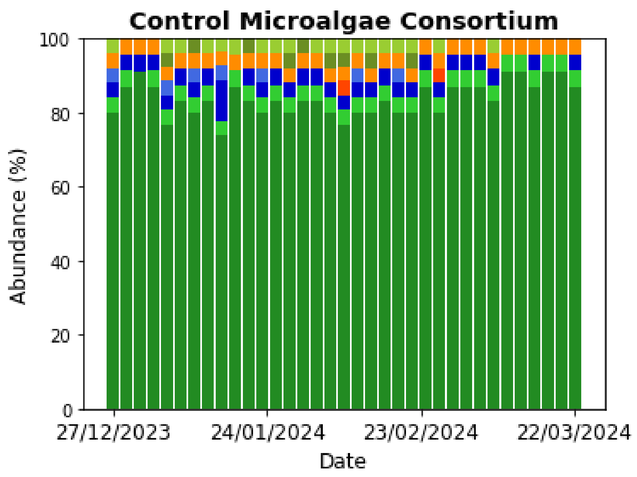
Methodology

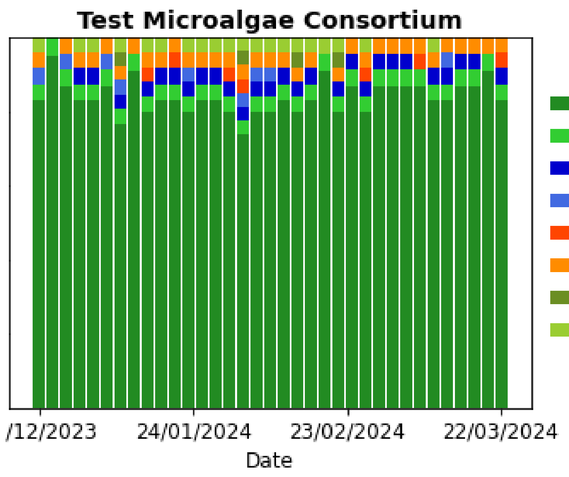
Reactor type: Pilot scale conventional raceway system.
Nº reactors: 2, one operated as control and one for tests.
Conditions tested: HRT=7 days (control), HRT=4 and 5.5 days (test).
Working volume: 700 L **Photosynthetic area:** 5 m^2
Operation mode: Semi-continuous.
Operation time: Between 27/12/2023 and 25/03/2024 (winter season).
Nº of treatment cycles : HRT=4 days - 15, HRT=5.5 days - 13 and HRT=7 days – 25
Culture media: Secondary effluent from a wastewater treatment facility receiving urban and industrial wastewater.

Results

Biomass

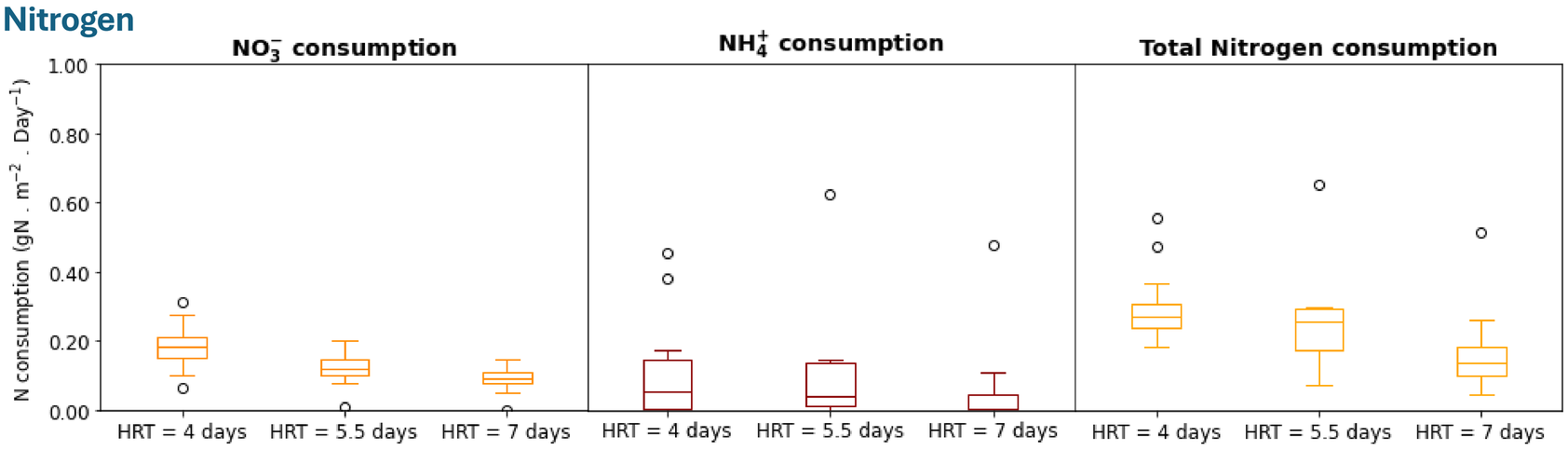


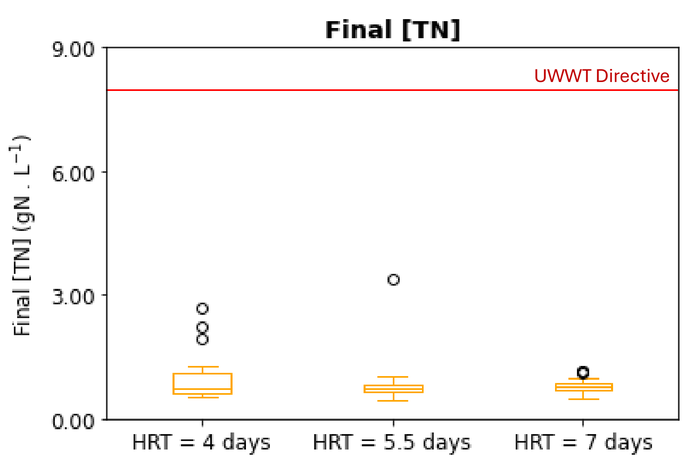




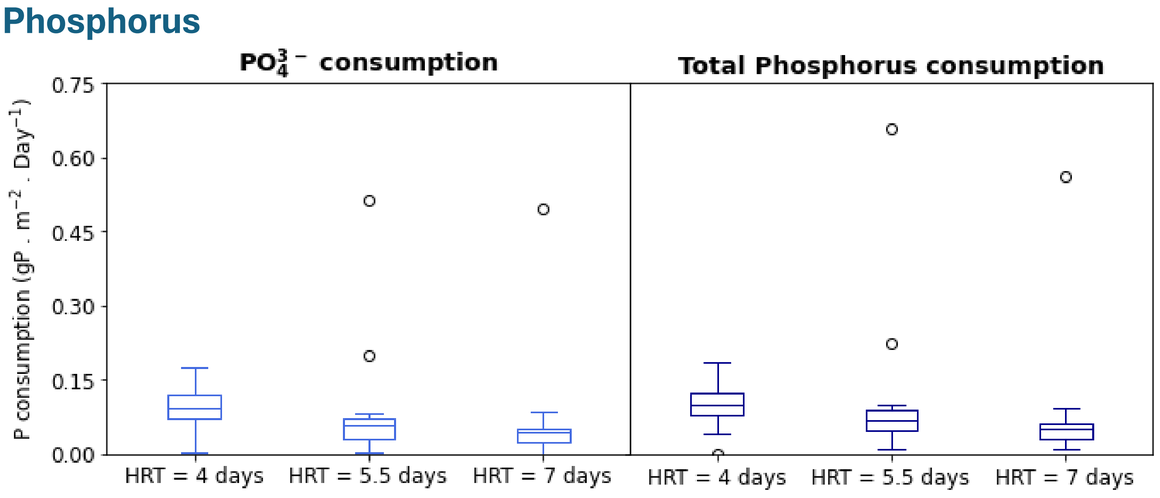
Final DW attained: 0.03 – 0.28 $g.L^{-1}$

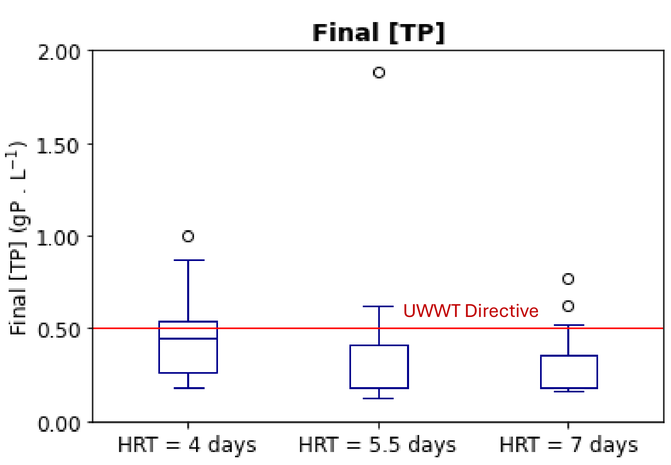
Nitrogen



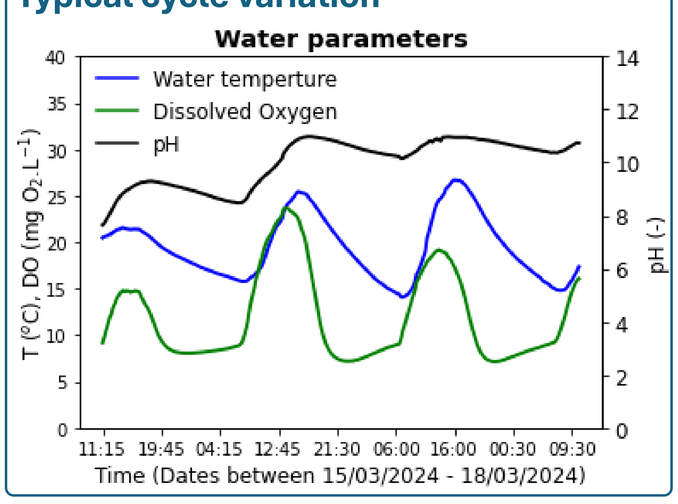


Phosphorus

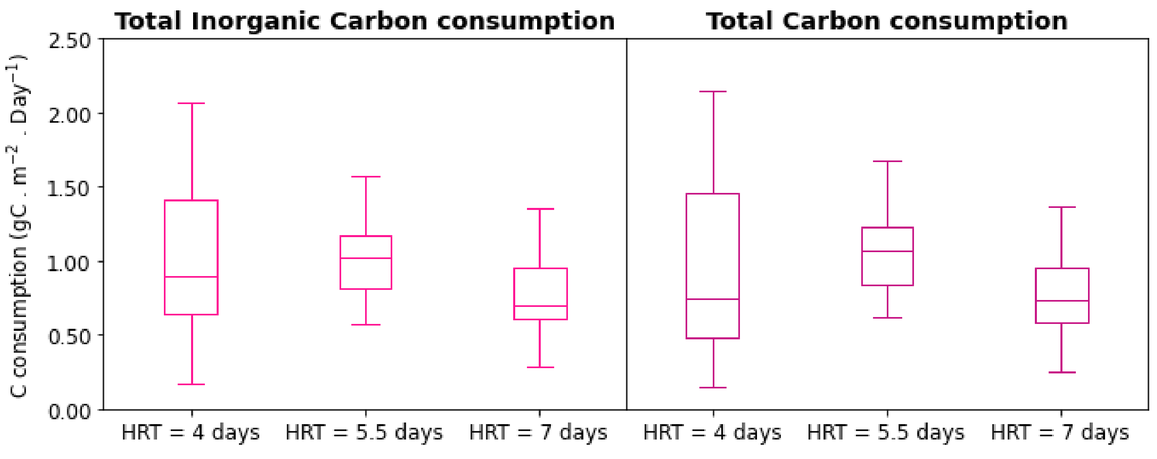




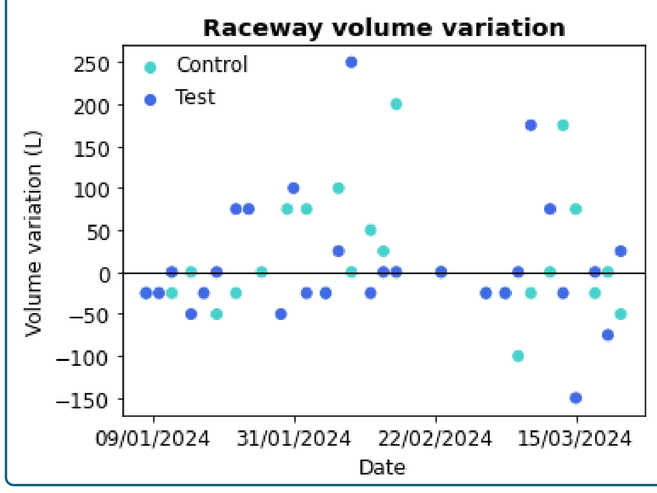
Typical cycle variation

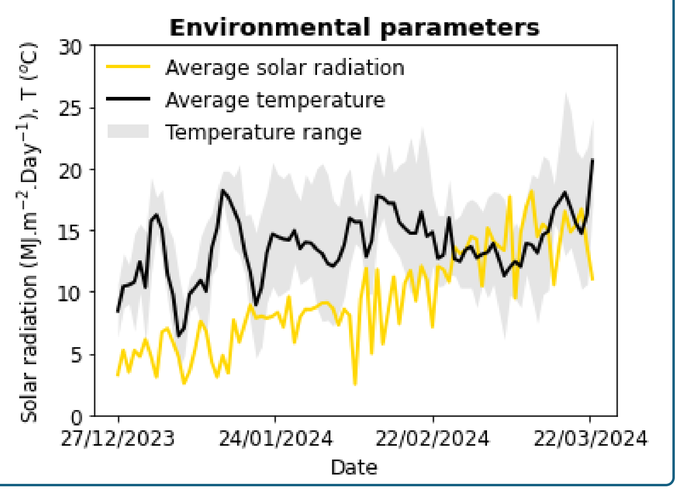


Carbon



Environment





Concluding remarks

- The microalgae treatment revealed to be **effective and robust for tertiary treatment**, even during the harshest season (winter).
- The final levels achieved for nitrogen and phosphorus were **compliant with the new European Directive demands** in most studied conditions.
- Inorganic carbon was removed from the wastewater as well as from the environment leading to a **negative carbon footprint**.

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