



**HAL**  
open science

## Using microalgae to capture organic pollutants from wastewater

Florian Littorie, Elisabeth A. Cazier, Pascale Gillon, Valérie Hequet

► **To cite this version:**

Florian Littorie, Elisabeth A. Cazier, Pascale Gillon, Valérie Hequet. Using microalgae to capture organic pollutants from wastewater. AlgaEurope, EABA, Dec 2024, Athens, Greece. hal-04848134

**HAL Id: hal-04848134**

**<https://hal.science/hal-04848134v1>**

Submitted on 19 Dec 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# USING MICROALGAE TO CAPTURE ORGANIC POLLUTANTS FROM WASTEWATER

Littorie, F.

Cazier, EA. ; Héquet, V. ; Gillon, P.

Nantes Université, Oniris, IMT Atlantique, CNRS, GEPEA, UMR 6144, F-44600 Saint Nazaire, France

## ABSTRACT

The industrial revolution and rapid urbanization have led to increased activity in various industrial sectors. Most of these industries consume large amounts of freshwater, producing wastewater containing numerous pollutants. These substances, which are increasingly diverse and harmful to organisms<sup>1,2</sup>, require contaminated wastewater to be treated more efficiently<sup>3</sup>.

Microalgae, already used in wastewater treatment<sup>4,5</sup>, appear to be a potential solution to this problem thanks to their ability to absorb and adsorb pollutants<sup>6,7</sup>.

In this study, we monitored the ability of two microalgae species, *Scenedesmus obliquus* and *Chlorella vulgaris*, to purify artificially contaminated water over 96 hours: (i) with a dye, Rhodamine B (RhB), between 0.5 and 5 mg.L<sup>-1</sup>, (ii) with a pharmaceutical molecule, paracetamol (APAP), between 1.5 mg.L<sup>-1</sup> and 15 mg.L<sup>-1</sup>. In addition to pollutant removal monitored by spectrophotometry, toxicity to microalgae was determined by examining growth, maximum quantum efficiency of photosystem II (Fv/Fm) and non-photochemical quenching of photosystem II (Y(NPQ)).

Using *S. obliquus* as an example, we observed a dose-response relationship for RhB through degradation rate and time. The maximum degradation rate of 53 % in 24 h was achieved for the lower dye concentration, while only 17 % was achieved in 96 h for the highest. For the same periods, a lower degradation rate was reported in the conditions without microalgae: only 9.9 % for the lowest dye concentration and 4.7 % for the highest. This indicates that the decrease in RhB was not due to abiotic factors.

Concerning APAP for both species, we did not find any effect of microalgae on this pharmaceutical removal. Conversely, the controls showed a higher degradation rate than the conditions with microalgae, suggesting an inhibition of photolysis by the algal cells.

The lack of effect on the physiological state of *S. obliquus* showed that it is resistant to APAP degradation and contributes to RhB degradation at these concentrations. In contrast, *C. vulgaris* was physiologically affected by the highest pollutant concentrations, showing a decrease in Fv/Fm values and a significant increase in Y(NPQ) associated with lower growth.

Based on the results obtained, *Scenedesmus obliquus* seems to be a potential candidate for phytoremediation.

## KEYWORDS

Microalgae, *Scenedesmus obliquus*, *Chlorella vulgaris*, phytoremediation, Rhodamine B, Paracetamol, Chlorophyll a fluorescence

## REFERENCES

1. Sharma, J., Sharma, S., Bhatt, U. & Soni, V. Toxic effects of Rhodamine B on antioxidant system and photosynthesis of *Hydrilla verticillata*. *J. Hazard. Mater. Lett.* **3**, 100069 (2022).
2. Vega-López, A., Ayala-López, G., Posadas-Espadas, B. P., Olivares-Rubio, H. F. & Dzúl-Caamal, R. Relations of oxidative stress in freshwater phytoplankton with heavy metals and polycyclic aromatic hydrocarbons. *Comp. Biochem. Physiol. - A Mol. Integr. Physiol.* **165**, 498–507 (2013).
3. Dutta, D., Arya, S. & Kumar, S. Industrial wastewater treatment: Current trends, bottlenecks, and best practices. *Chemosphere* **285**, 131245 (2021).
4. Goswami, R. K., Agrawal, K. & Verma, P. Microalgal-based remediation of wastewater: A step towards environment protection and management. *Environ. Qual. Manag.* **32**, 105–123 (2022).
5. Wollmann, F. *et al.* Microalgae wastewater treatment: Biological and technological approaches. *Eng. Life Sci.* **19**, 860–871 (2019).
6. Phukan, D., Kumar, V., Singh, A. & Anand, S. Accessing biochemical shifts in a novel *Scenedesmus* strain via acetaminophen detoxification: Experiment utilizing Box-Behnken optimization and isotherm analysis. *Int. Biodeterior. Biodegrad.* **193**, 105841 (2024).
7. Gattullo, C. E., Bährs, H., Steinberg, C. E. W. & Loffredo, E. Removal of bisphenol A by the freshwater green alga *Monoraphidium braunii* and the role of natural organic matter. *Sci. Total Environ.* **416**, 501–506 (2012).

## SPEAKER INFORMATION



### LITTORIE Florian

PhD Student, CNRS  
France

[www.linkedin.com/in/florian-littorie-834674173](https://www.linkedin.com/in/florian-littorie-834674173)

### BIOGRAPHY

Curious since childhood and concerned about the future of our planet and our species, I've always been interested in ecological and environmental research. I first turned to the world of aquaculture, seeing it as a potentially sustainable way of exploiting the sea. After completing a Master's degree in Marine Sciences at the University of Caen in Normandy, I had the opportunity to work as a research engineer in an oyster and clam hatchery. During my 5 years with the company, I had the opportunity to work on a wide range of topics, including the control of shellfish pathogens, research into alternatives to antibiotics in aquaculture, optimisation of mollusc larval production and improvement of microalgae production using photobioreactors. Having gained this experience, I felt the need to acquire a solid knowledge in scientific research.

That's why I'm currently doing a PhD in Process Engineering, with a thesis on the development of a hybrid process for the treatment of polluted water using microalgae in the presence of macroporous 3D structures based on metal oxides.

This thesis is part of the European 'Water Green Treat' project, which aims to regenerate wastewater through a synergistic effect induced by 3D printed photocatalytic structures based on ecogenic metal oxides and microalgae for use in agriculture. In this way, being part of this project is a great opportunity for me, thanks to the possibility of contributing to the development of new eco-friendly technological solutions.

### ORGANIZATION PROFILE

GEPEA is a French academic laboratory of Université of Nantes, IMT Atlantique and CNRS involved in Process engineering for environment and food. The authors would like to thank the European Commission and the French Agence Nationale de la Recherche ANR for funding in the frame of the collaborative international consortium WaterGreenTreat financed under the 2022 Joint call of the European Partnership 101060874 — Water4All.