Design of Smart Flocculants for the Harvesting of Microalgae via a Grafting – to Strategy of thermosensitive polymers onto Cellulose Nanocrystals

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Microalgae are a promising feedstock for biosourced materials (biofuels, pigments, vitamins, etc.). However, the production of microalgae on a large scale remains limited by the enormous cost of the harvesting phase which constitutes 20 to 30% of the total cost, due to the small size of the microalgae (3 – 30 µm), and the low concentration in the culture medium (0.5 – 5 g/L) which makes all conventional harvesting techniques long and energy-intensive [1].
In order to solve this problem, the use of a flocculating agent in the harvest process seems an interesting approach [2]. Microalgae have negatively charged proteins on their membrane walls which give them significant colloidal stability in their culture medium. Flocculants are chemical compounds, positively charged, which interact with microalgae to form aggregates which can then be separated by sedimentation or flotation. However, the flocculants used generally remain trapped in the biomass and contaminate it with toxic residues, which limits their final applications [3].
This thesis subject therefore aims to develop a new family of flocculants based on cellulose nanocrystals modified by cationic centers (to induce flocculation) and by thermosensitive polymer chains (to selectively mask and unmask the cationic charges to harvest and/or recycle the flocculant). This approach will constitute the first example of the use of cellulose nanocrystals modified with thermosensitive polymers in the field of microalgae harvest.

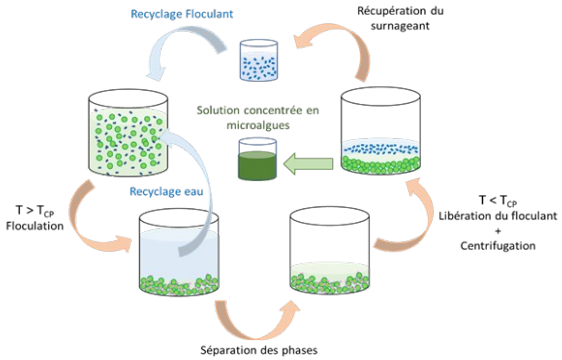

Figure 1 Representation of the complete targeted microalgae culture cycle, flocculation, concentration of the solution in microalgae and release/recycling of flocculant.

Keywords: Microalgae, Flocculant, Thermosensitive polymers, Cellulose nanocrystals (CNCs)

Acknowledgments
The authors gratefully acknowledge the "Région Normandie" for the funding of this PhD, and the ERASMUS+ program for the financial support provided during the research mobility to Belgium.

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