

PhD position: Design of microbial membrane structured microreactors and immobilised cells for intensified sustainable bioproduction

This PhD proposal is part of a project funded by the University of Toulouse and Région Occitanie. The main objective of this thesis is to design an original reactor in which a hydrogel is used as a membrane-supported inclusion matrix, to enable both immobilization and densification of cells in order to enhance the performance of bioproductions within spatial constraints of containment and/or water consumption.

In order to meet the challenges of intensifying bioprocesses within the framework of sustainable bio-sourced itineraries, this project proposes to design a reactor for densifying microorganisms of interest in matrices supported by a membrane. The challenge is to maximise production performance (productivity, yields and/or titles) by reducing the mechanical constraints and physiological stresses that alter microbial activity and therefore performance. The development of a membrane reactor in which the microorganisms are immobilised in hydrogels can thus be a relevant solution by combining high concentrations of catalytic biomass and high titers or productivities while allowing a saving of steps for the extraction/purification of the targeted microbial products. In addition, this configuration minimises the amount of water present in the process, combining reaction and separation, generating economic and environmental gains and making it more competitive than current processes.

The intensification of performance in the microreactor will require the identification of the factor(s) that limit(s) the biological kinetics to optimise the operating conditions. This will involve the characteristics of the supporting matrix (biocompatibility, structure, porosity, thickness, etc.), the water content as well as the feeding methods (flows, fluxes) which will affect the transfers within the immobilisation matrix.

The experimental results obtained will be evaluated by modelling tools for transfers and microbial kinetics in a dense environment with a view to optimising targeted bio-production via the relevant operating conditions.

The PhD will be supervised by Dr. ALFENORE Sandrine (TBI, Toulouse Biotechnology Institute) and Dr. Clémence Coetsier (LGC, Laboratory of Chemical Engineering – Toulouse)

Profile: The applicant should have a Master degree in Materials science or engineering and/or process or bioprocess engineering. Curiosity and interest in methodological developments and interdisciplinary topics is essential. Knowledge / experience in membrane processes applied to bioprocesses, experience in microbial cultures and/or microscopic techniques will be an additional asset for this project. Motivation, autonomy, team spirit and working skills will be the main motors for a successful project.

Teaching opportunities at Toulouse University

Duration: 36 months,

Net wages: ~2000 €/month

Starting date: The position is to be filled by the end of 2023.

Location: Toulouse Biotechnology Institute, INSA Toulouse

Contact: Sandrine Alfenore (TBI) alfenore@insa-toulouse.fr and Clémence Coetsier (LGC) clemence.coetsier@univ-tlse3.fr