OFFER OF MASTER INTERNSHIP (M2/M1)

ODYSSEUS: Optimization of carbon Dioxide and oxYgen maSS transfer in biorEactors: a mUltiscale Study

Laboratory

Laboratory: **Toulouse Biotechnology Institute (TBI) INSA UMR CNRS 5504 UMR INRA 792**
Web: https://www.toulouse-biotechnology-institute.fr/
Research Group: **Equipe TIM (Transfert Interface Mélange)**
Web: https://www.toulouse-biotechnology-institute.fr/poles/equipe-tim/

Description the the internship

The performance of fermentation bioreactors is strongly related to the oxygen transfer from air bubbles to microorganisms to improve their growth. The action of the bubbles helps mix the reactor and also strips out waste gases (carbon dioxide). However, accurately characterizing the gas-liquid mass transfer in such processes is still a challenging issue, mainly because of the liquid phase complexity. The aim of this internship is to develop specific techniques and rigorous models to better estimate the various mechanisms that govern the mass transfer process locally. This internship is a part of the ANR project ODYSSEUS ("Optimization of carbon Dioxide and oxYgen maSS transfer in biorEactors: a mUltiscale Study "), which objective is to predict the CO2 and O2 mass transfer in bioreactors, considering the physicochemical properties of the culture media at different scales (from molecular thermodynamics, cell and bubble scale to the reactor scale) and the local hydrodynamics. This project presents theoretical developments to increase the knowledge of transfer phenomena in complex systems. It also presents important practical and engineering aspects, with potential industrial impact on bioreactor efficiency.

The Objective of the internships are (i) Measurement of CO2 and O2 solubilities in biomedia; (ii) Measurement of dissolved gas CO2 and O2 diffusion coefficient measurements in biomedia. The global objective is to deals with the full characterization of the multiphase system including the physical properties of the assembled particle and the thermodynamics parameters of gas-liquid systems (diffusion coefficients & oxygen solubility). Even if these properties are well known for pure gas concentration in water or model fluids, they are not so far systematically studied in biological media nor for gas mixtures. In order to assess the equilibrium properties of O2, CO2 and O2/CO2 mixtures to get the solubility of each gas composition, a home-made setup will be used to measure Henry's law constants of gas mixtures. The apparatus brings gas and liquid phases into contact before and after equilibrium in medium pressure conditions (from 1 to 10 bars). Standard sensors will continuously record temperature, pressure, and phase concentrations of the components so that the Henry's law constant can be calculated. These investigations of Henry constant and activities coefficients in biological media is still of primer importance today to figure out the mass transfer prediction into biological reactors.

Applicant

Master Student (BAC+ 4 or 5/M1 or M2), End of studies internship, 6 months maximum, 3 months minimum
Specialty: Chemical engineering, physical measurements, environmental quality, chemistry, or engineering
In view of the expectations of the internship, a strong interest for experimental is recommended. The Internship is paid according to the rules (according to the monthly working time paid at 3.90 €/h). Start of the internship: from 01/02/2023
Supervision: Professor Nicolas Dietrich INSA EAD7 www.ndietrich.com

Send CV and cover letter including the professional project envisaged to: dietrich@insa-toulouse.fr

A funding to pursue in a PhD thesis is already acquired (starting October 2024-October 2027).