

PhD position at IMT Atlantique in collaboration with Aalborg University

Title: Design and implementation of a continuous hydrothermal liquefaction reactor tailored to the production of biocrude from a lipid rich microalgae strain

Keywords: Hydrothermal liquefaction, microalgae, Advanced biofuels, Aviation, Maritime, Continuous reactors

Academic environment:

IMT Atlantique, internationally recognised for the quality of its research, is a leading general engineering school under the charge of the Ministry of Industry and Digital Technology, ranked in the three main international rankings (THE, SHANGHAI, QS). Located on three campuses, Brest, Nantes and Rennes, IMT Atlantique aims to combine digital technology and energy to transform society and industry through training, research and innovation. It aims to be the leading French higher education and research institution in this field on an international scale.

The Energy Systems and Environment Engineering Department (DSEE) is located on the Nantes campus of IMT Atlantique. Approximately 70 people work in this department, including 20 permanent teacher-researchers (10 HDR), 6 engineers and technicians as well as 3 administrative staff, PhD students, research engineers, and post-doctoral fellows. As part of the GEPEA UMR CNRS 6144 laboratory, the department conducts research in process engineering applied to bio-resources and environmental technologies through 3 research groups : Air Metrology Water Treatment (TEAM) ; Energy/Material Recovery of Residues and Treatment of Emissions (VERTE) ; Optimization – Systems – Energy (OSE). The department created the PREVER platform in 2014 to research and study the energy recovery of residues and the SafeAir platform to treat air pollutants. The Ph.D. work will take place in the DSEE under the VERTE research group.

Located in Northern Denmark, **Aalborg University** (AAU) has been ranked as the best engineering university in Europe, according to the prestigious 'Best Global Universities' ranking. COCPIT activities are managed by the Advanced Biofuels research group within the AAU Energy department, a world-leading research institution engaging in green transition. The Advanced Biofuels research group involves around 15 researchers, focusing on biofuels production from biomass by means of hydrothermal liquefaction (HTL) and hydroprocessing, chemical recycling of plastics, CO₂ capture and utilization, including both experimental and modeling activities. The group is one of the most active on the global scene for HTL-based biofuels production and runs several national and international research projects on this topic, in collaboration with an extensive network of academic and industrial partners.

Context: Aviation and maritime sectors are often referred to as the most difficult sectors to be electrified in the upcoming decades. Their pathways to decarbonation by 2050 will pass through sustainable fuels, including biobased ones. ASTM International has so far certified 7 pathways to produce sustainable aviation fuels (SAF), and new ones are under development and testing, including hydrothermal liquefaction (HTL) followed by an upgrading step. This process offers several advantages including its ability to process wet biomass like microalgae (having a high potential as a feedstock of advanced biofuels) and its flexibility in terms of feedstock and final fuel ranges (for shipping, road and aviation).

The Ph.D. offer lies within the framework of **COCPIT (scalable solutions Optimisation and decision tool Creation for low impact SAF Production chain from a lipid-rich microalgae sTrain)**, a project funded by EU under the Horizon Europe, cluster 5, agreement n° 101122101. It gathers 11 partners from 6 EU countries coordinated by IMT Atlantique.

IMT Atlantique Bretagne-Pays de la Loire - www.imt-atlantique.fr

Campus de Brest
Technopôle Brest-Iroise
CS 83818
29238 Brest Cedex 03
T +33 (0)2 29 00 11 11
F +33 (0)2 29 00 10 00

Campus de Nantes
4, rue Alfred Kastler - La Chantrerie
CS 20722
44307 Nantes Cedex 3
T +33 (0)2 51 85 81 00
F +33 (0)2 51 85 81 99

Campus de Rennes
2, rue de la Châtaigneraie
CS 17607
35576 Cesson Sévigné Cedex
T +33 (0)2 99 12 70 00
F +33 (0)2 99 12 70 08

One of the tasks of COCPIT consists in the construction of a continuous HTL reactor, fully tailored to a lipid rich microalgae strain. The design step will be performed by combining experimental campaigns and mechanistic modelling of thermochemical phenomena occurring during the reaction.

Objectives: The purpose of this Ph.D. is to study the HTL process of a lipid-rich microalgae strain having different protein (nitrogen) contents on different HTL batch and continuous reactors at IMT Atlantique (France) and Aalborg University (Denmark), before designing and constructing a two stage HTL continuous reactor that is meant to operate at the end of the project for 100 h consecutive hours.

Tasks:

- Characterising microalgae
- Testing microalgae having different protein contents at different batch and continuous reactors
- Characterising the resulting products
- Contributing to the design, construction and operation of a new HTL continuous reactor
- Contributing to the study of the energy efficiency of the system (energy balance and heat recovery solutions)
- Participating to COCPIT consortium meetings
- Writing publications and advancement reports to the EU commission
- Participating to communication and dissemination events

To perform these tasks the Ph.D. student will collaborate with a post-doctorate fellow and an intern recruited for complementary tasks and will rely on the help of both institutions' technical staffs.

Candidate's profile: we are looking for candidates having a M.Sc. degree in one of the following domains: chemical, mechanical, process or environmental engineering. He/she should have a first experience (internship, projects, courses) in topics related to the subject (thermochemical processes, biofuel production, CFD, experimental set-up, analytical equipment etc.). She/he should have very good English writing skills.

Schedule and location:

The Ph. D. student will be enrolled at IMT Atlantique's doctoral school (SPIN) and co-supervised by IMT Atlantique and Aalborg University academic staff. He/she will pass 12 months at Aalborg University (Aalborg – Denmark) and 24 months at IMT Atlantique (Nantes – France) as follows:

October 1st, 2023 – September 30th, 2024 at Aalborg University, Aalborg, Denmark

October 1st, 2024 – September 30th 2026 at IMT Atlantique, Nantes, France

Supervision:

Sary AWAD, Associate Professor at IMT Atlantique,

Daniele CASTELLO, Associate Professor at Aalborg University,

Salary

At Aalborg University: Hired as a research assistant, around 2400 € net/month + pension contributions

At IMT Atlantique: Hired as Ph.D. Student, 1696 € net/month

Application

To apply for this position please send a CV, a motivation letter a recommendation letter (or list of 2 referees) and Msc transcripts to sary.awad@imt-atlantique.fr

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F +33 (0)2 29 00 10 00

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4, rue Alfred Kastler - La Chantrerie
CS 20722
44307 Nantes Cedex 3
T +33 (0)2 51 85 81 00
F +33 (0)2 51 85 81 99

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2, rue de la Châtaigneraie
CS 17607
35576 Cesson Sévigné Cedex
T +33 (0)2 99 12 70 00
F +33 (0)2 99 12 70 08