Faculté des Sciences Appliquées
Department of Chemical Engineering
PEPs – Products, Environment, and Processes
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PhD thesis offer

Direct CO_2 capture leveraging existing gas treatment infrastructures

Hamon group and the University of Liege have initiated collaboration on the development of a direct air capture technology that uses existing equipment for flue gas treatment. A 4-year PhD position is currently offered in the context of a project submitted to the Walloon Region (Industrial Internship) by Hamon group and PEPs-Chemical Engineering at the University of Liège (Belgium).

Research area – The Project:

Reducing CO_2 emissions is a key challenge of the global energy transition. Among other technologies, Post-Combustion CO_2 Capture (PCCC) and Direct Air Capture (DAC) technologies are promising solutions with high and low maturity respectively but in both cases with high potential impact. They can respectively contribute to considerably reduce our CO_2 emissions in the environment by capturing CO_2 from concentrated emitters such as industries or thermal power stations (case of PCCC), or to eliminate CO_2 from the atmosphere (case of DAC), at any location favorably chosen.

The Hamon group has expertise and a customer base in the field of air treatment, whether in flue gas cleaning or in air flow cooling. It is ideally positioned to offer its customers around the world CO_2 capture technologies. In addition, it masters the inputs of CO_2 capture processes, whether fumes, heat flows, water streams, as well as the equipment intended to treat these flue gases (cooling towers, air conditioning and cooling). The University of Liège has more than 12-year experience in CO_2 capture and flue gas treatment. It already disposes of experimental and numerical tools for the characterization of CO_2 capture technologies, mostly focusing on post-combustion capture.

The objective of the research is to take advantage of industrial equipment of the type already offered by Hamon to its customers by grafting it with a technology allowing the capture of CO_2 in the treated gas streams, whether concentrated CO_2 streams or air flows. Many technologies exist for the capture of CO_2 in flue gas, and a few of them are applicable to direct air capture. However, these generally do not take advantage of existing industrial infrastructure for air treatment, so the investment costs necessary for their deployment are prohibitive. This research therefore aims to identify the most promising technologies in relation to the infrastructures available in the industry and to develop technological solutions that leverage these strengths.

Description of the tasks:

To successfully perform the research, an in-depth understanding of the mechanisms of CO_2 capture in different types of materials will be acquired by different means: a pilot installation of CO_2 capture study will be developed, and a numerical model will make it possible to understand the influence of operating conditions on CO_2 capture. Different CO_2 capture materials will be studied, some described in the literature, others potentially developed at ULiège, and their use in innovative processes will be optimized.

The PhD thesis job also includes participation to project meeting, presentation of results at national and international conferences, writing of scientific articles... in the respect of project confidentiality.

The successful candidate will receive a position for a two-year period, once renewable (4 years in total). The grant amount is in accordance with university standards (~1900 €/month, net).

Candidate's profile:

Candidates must have graduated (Master's degree) in Chemical Engineering or similar field (process, energy, mechanical, or environmental engineering…). They should have a strong interest in process design, lab set-up construction and experimental work. Modeling experience is a plus, either with flowsheeting tools such as AspenOne software (or similar) as well as numerical programming (Python, Matlab…). They should also be able to work in relative autonomy typical for PhD thesis, as well as to easily interact with academic and industrial partners. They should demonstrate ability to synthesize information from a literature review, they should master writing of mass and enthalpy balances, have a good understanding of thermodynamics, kinetics, and fluid dynamics issues. Ease to communicate in English (oral and written) is required, French is an additional asset.

Research environment:

This is an industrial thesis, meaning that the PhD student will carry out his/her research between ULiège and Hamon sites. Regular and joint supervision will be provided by Hamon group and the University of Liège.

Hamon, founded in 1904 and based in Mont-Saint-Guibert (Belgium), is one of the leading global players in air pollution control and cooling technologies. With its more than 1000 employees and offices based all over the world it offers smart and customized solutions to clients mainly in the power, steel and process industry. The candidate will join a dynamic and international team. Care of the candidate will be through R&D department of the Hamon Group which is staffed with Belgian, Dutch, German and Czech colleagues. The R&D department develops and owns all experimental research activities of the Hamon group. It has experience in

physical measurements (on sites globally and in its own test facility in Belgium), preparing studies of physical and chemical content as well as modelling complex processes with CFD and other tools. With a Linux-based HPC cluster available at the Bochum location and the computing power available with it, Hamon has been performing computer-aided simulation (CFD) for the entire Hamon Group for 15 years. The portfolio of CFD simulations covers the entire technology spectrum of the Hamon Group, from cooling systems to gas cleaning systems. In the context of CFD-based optimization of cooling systems, Hamon has extensive experience in the use of stochastic methods such as the "Design of Experiments" (DoE), variance-based sensitivity analysis, mathematical substitute models and automated optimization.

At ULiège, the successful candidate will join a dynamic and growing team within the PEPs group of the Department of Chemical Engineering (DCE). The DCE employs about 60 people mostly active in the fields of process engineering and materials science. The Department develops experimental research activities, as well as modeling and control studies of physical, chemical and biological processes to enable the emergence of sustainable and economically viable materials and technologies. The present research project will be conducted in an international-friendly environment, with more than a dozen different nationalities present in the DCE. The DCE is also an active member of the FRITCO$_2$T platform (Federation of researchers in innovative technologies for CO_2 transformation) at ULiège, and a founding member of the CO_2 Value Europe Association. More information about the Department of Chemical Engineering:
www.chemeng.uliege.be

The academic PhD supervisor will be Prof. Grégoire LEONARD, active in the field of process modeling and CO_2 capture & reuse. See publications:
https://orbi.uliege.be/simple-search?query=gr%C3%A9goire+l%C3%A9onard

Recruitment process:
Applications containing CV, cover letter and possibly reference letter should be submitted by e-mail to secretary.chemeng@uliege.be with in object the mention “Application industrial PhD ULiège-Hamon”. Application deadline is April 18, 2021.

Candidates selected from this first round will be invited for an interview (video conference) during which they will be asked to present their competences in relation to the job offer.