

PhD thesis offer

CO₂ capture and storage via carbonatation of mineral wastes

A 4-year PhD position is currently available in the Department of Chemical Engineering at the University of Liège (Belgium). This offer is done in the context of a project funded by the Walloon Region (Greenwin competitiveness cluster) implying a total of 6 Belgian partners.

Research area – The Project:

Mineral wastes (demolition wastes, flying ashes from flue gas treatment etc.) constitute by far the largest mass of wastes produced by our society, and their recycling is currently poorly developed and they are instead usually landfilled. Unlike metals, recycling mineral waste is currently economically difficult, especially because of the low value of by-products. The environmental impacts and the costs of landfilling are however very important, especially when these wastes are polluted with undesirable components (legislative constraints relating to landfilling are increasingly strict). As a consequence, the consortium has agreed to study a technical solution for the carbonatation of mineral wastes that would allow them to be recycled as construction materials. This project would deliver 3 main impacts:

- Propose an innovative solution for the treatment of mineral wastes to reduce the landfilled volume and the associated environmental and economic impacts,
- Capture and store industrial CO₂ exhausts under the form of stable carbonates, contributing to a net and significant decrease of the CO₂ emissions to the environment,
- Reduce the extraction of raw materials in the linear take-use-throw mindset and provide instead environmentally friendly and economically viable raw materials from a recycling loop, in agreement with the concepts of circular economy.

Description of the tasks:

In the project, the role of the PhD student will be to develop numerical models for the carbonatation process. This includes a detailed understanding and modeling of the thermodynamics and kinetics of the carbonation reactions, as well as a comprehensive study of associated mass and energy transfers and fluid dynamic aspects in multi-phase systems. The modeling study will lead to the design of relevant equipment for the carbonatation reaction, but other process steps including pre- and post-treatment of the reactants and products may also be considered in the model.

Close interaction with project partners will be needed, not only to feed experimental data collected by other partners or from literature into the model, but also to validate the model. The control strategy of the process will be studied as well, in order to optimize its

performances. Finally, modeling results will also be used by internal partners to conduct a life cycle assessment of the developed technology.

The PhD thesis job 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 PhD student position for a 4-year period, starting ideally from March 1st, 2021. 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, mechanical, or environmental engineering...). They should have a strong interest in numerical modeling. Previous experience in this field 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:

The successful candidate will join a dynamic team within the Department of Chemical Engineering (DCE) of the University of Liège. The DCE employs about 60 people mostly active in the fields of process engineering and materials science. Within the DCE, the PEPs group (Processes, Environment and Products) performs experimental research activities, as well as studies the modeling and control of physico-chemical and biochemical processes. It targets the development and optimization of innovative materials and processes that are also sustainable and financially viable. The present research project will be conducted in an international-friendly environment, with more than 10 different nationalities present in the DCE.

The DCE is also an active member of the FRITCO₂T platform (Federation of researchers in innovative technologies for CO₂ transformation) at ULiège, and a founding member of the CO₂ Value Europe Association.

More information about the Department of Chemical Engineering:

www.chemeng.uliege.be

Two professors will be in charge of mentoring this PhD thesis:

Prof. Dominique TOYE, active in the field of reactors design and modeling. See publications:

<https://orbi.uliege.be/simple-search?query=dominique+toye>

Prof. Grégoire LEONARD, active in the field of process modeling and CO₂ 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 PhD thesis Carbonatation”. Application deadline is January 31th, 2020.

Candidates selected from this first round will be invited for an interview (possibly through video conference) during which they will be asked to briefly present a previous topic they worked on.

Start of the PhD should ideally take place on March 1st, 2021.