UMONS
Université de Mons

FEDER – FSE
UNION EUROPEENNE
Wallonie

DECARBOWAL – CRUCIAL - SORBINNOV PROJECT
Post-Doctoral position:

"Innovative adsorbents investigation for carbon capture"

Context:

The work will be carried out at the Faculty of Engineering (FPMs) of UMONS in the framework of the "SORBINNOV project" funded by the FEDER/ERDF (European Regional Development Fund). The project is included in a project portfolio named "DECARBOWAL". It concerns the thematic of carbon capture.

Indeed, reducing the CO_2 emissions is mandatory to meet the objectives in terms of greenhouse gas effect limitation, but implementing carbon-negative solutions is also a necessity will still have "unavoidable CO_2 emissions" for several years. Such operation is possible thanks to the Direct Air Capture (DAC) of CO_2. The SORBINNOV project is focusing on two CO_2 capture technologies, gas-solid adsorption and the gas-liquid absorption, applicable to both the industrial flue gases (CO_2 contents from 5% to 30%) and the air (CO_2 content around 0.04%). The present offer is related to the adsorption technology.

More precisely, as the core of the adsorption CO_2 capture technology is the adsorbent material, investigating new adsorbents and/or new shaping is still mandatory in order to develop a more economically competitive technology, allowing to capture the CO_2 with a high recovery rate and to recover a CO_2 as pure as possible. Different classes of adsorbents exist to capture CO_2, and they are at very different stages of technological development. For example, we can mention activated carbons and zeolites as well as, various classes of MOFs (Metal Organic Frameworks) or porous solids, grafted or impregnated with amine groups, which are innovative adsorbent materials with high promising potential.

The objective of the work will be to determine material specifications: establishing (or validating) KPIs for monitoring adsorbent performance as a function of applications (CO_2 adsorption capacity, CO_2/N_2 selectivity, heat of adsorption), stability in the presence of contaminants, in order to draw up and update list of candidate MOFs and porous solids grafted or impregnated with amines. The status of patents relating to the structure of each material, synthesis and scale-up while limiting environmental impact (use of aqueous solvents non-toxic metals), as well as shaping, will also be analyzed and considered as key parameters for the project. The selection of MOFS for industrial flue gas treatment will be based in particular on developments carried out in the H2020-MOF4AIR project (Metal Organic Frameworks for Carbon Dioxide Adsorption Processes in Power Production and Energy Intensive Industries - https://www.mof4air.eu/), coordinated by UMONS.

Area of the proposed research:

For reaching the project objectives, the following tasks will be performed:

- updated technological reviews on adsorption-based carbon capture systems and especially on the innovative adsorbent materials: 2 or 3 promising adsorbents will be selected as potential candidates for experiments;
- validation the selection of the best MOFs for CO_2 capture, both for application to industrial flue gases (CO_2 contents from 5% to 30%) and for the capture in ambient air (CO_2 content around 0.04%) from the list of potential candidates;
- characterization of a set of selected samples on a few grams scale in powder form: pure-component adsorption isotherms, mixed-components breakthrough curves: evaluation of working capacity, CO_2/N_2 selectivity, regeneration performances (via TSA – Temperature Swing Adsorption, (V)PSA – (Vacuum) Pressure Swing Adsorption), stability under a flow considering different gas mixtures (gas concentration, presence of water, contaminants (SOx or NOx), temperature, etc.);
- in a second phase, shaping tests will be carried out to find the most plausible formulation in terms of mechanical stability, working capacity, pressure drop of the shaped adsorbents, giving optimum volumetric adsorption capacity for CO_2 adsorption capacity and CO_2/N_2 selectivity of the selected materials. Co-adsorption isotherms, as well as breakthrough curve experiments will be carried out to study competitive adsorption, mass transfer and heat transfer parameters, and to measure kinetic constants for the adsorption of the various components.

The post-doctoral works will also naturally include different dissemination activities: reporting, scientific publications and presentations in international conferences.

During the works, several exchanges will be necessary with internal collaborators (PhD students, post-docs, etc.) and also with external collaborators such as other universities or research organisms, industrials, technology providers, etc.

Candidate's profile:

Education: Candidates must hold a PhD degree in Chemical engineering/Chemistry/Engineering Sciences or fields (such as industrial chemistry, mechanical/ environmental engineering, …) with a strong interest in chemistry, energy, environment, process engineering. Any previous experience in relation with carbon capture, especially by adsorption, would be an asset.

Languages: A good knowledge of English is required, both oral and written; a knowledge of French would be an asset.

Other skills: Any experience related to adsorption tests and adsorbent characterization would be an asset. Writing skills, good interpersonal and communication skills, rigor and conciseness will be highly appreciated.

The candidate will be hosted in a nice working environment under a challenging job at a dynamic and ambitious University, and in a context with several other PhD students/Post-docs working on carbon capture and utilization. Salaries are in accordance with the internal University agreement.

The Post-Doc is expected to start as soon as possible in 2024 for a duration until December 2025.

Recruitment procedure:

Applications (CV + motivation letter showing the adequacy with the requested profile + eventual letters of recommendation) should be sent by email to:

Prof. Guy DE WEIRELD: guy.deweireld@umons.ac.be ; +32(0)65/37.42.03

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After a first selection based on the CV, the recruitment procedure will include minimum two interviews comprising a first remote interview by Microsoft Teams or phone, and a second interview (ideally in live at UMONS) including a short presentation by the candidate.