

PhD POSITION (36 months) CHEMICAL ENGINEERING & ENERGETICS

DESIGN OF INNOVATIVE SOLAR POWERED VACUUM MEMBRANE DISTILLATION MODULES AND ENERGY EFFICIENT SYSTEM

Within EU Marie Skłodowska-Curie Doctoral Network (HORIZON-MSCA-DN)

EXBRINER

(ESR position 3, recruiting institution : INSA Toulouse, France)

CONTEXT = THE EXBRINER PROJECT

Marie Skłodowska-Curie Doctoral Network HORIZON – MSCA – 2021 – DN **EXBRINER** (<http://exbriner.unical.it>) is designed with the ambition to provide high level training to a talented cohort of 10 PhD students who will work in a multidisciplinary and international environment with the aim to develop **next-generation membrane technologies for sustainable exploitation of desalination brine resources**, thus accelerating the **transition towards a Circular Blue Industry**. EXBRINER is implemented through a cross-sectoral Network, composed by 9 European Universities, 2 Research Centers and 4 leading Industrial Companies from 8 EU Countries (Italy, Belgium, Czechia, Denmark, France, Germany, Portugal, Spain), all with recognized excellence in the field of membrane engineering.

The doctoral program EXBRINER is built on three main pillars:

- Design next-generation functional membrane materials for hypersaline brine treatment;
- Implement membrane-based crystallization techniques for recovery of minerals;
- Develop innovative electrochemical membrane processes for brine valorization /energy generation.

INDIVIDUAL RESEARCH PROJECT & RESPONSABILITIES

The PhD will contribute to EXBRINER Work Package 3 “Advanced based crystallization techniques for recovery of minerals”.

The main objectives of the PhD project are **to design, optimize and test an innovative solar heated and membrane distillation module and global system for the concentration of brines** (monovalent streamlines from advanced nanofiltration). The challenge is to integrate microporous hydrophobic hollow fiber membranes and direct solar heating in the same Vacuum Membrane Distillation module in order to reduce the heat losses and to gain sustainability.

The work will consider mass/heat transfer through the module, vacuum, condensation and heat recovery integration, wetting risk and related countermeasures, and electric needs and productivity as a function of solar radiation. The influence of MD retentate properties on the performances of the subsequent stage in the global treatment route envisioned in EXBRINER (Donnan dialysis) will be investigated.

The approach requires both numerical simulations, multi-criteria optimization and experimental explorations based on module prototyping and pilot testing with real/synthetic concentrates and under both controlled solar irradiation and real exposure.

The PhD will explore the following tasks:

- 1) Designing an intensified membrane module coupling VMD and solar collector for a better use of heat for the treatment of brines, based on 2D modeling, multi-criteria optimization, prototyping and testing;
- 2) Evaluating system performances (productivity, energy consumption) and improving global energy efficiency by heat recovery and storage;
- 3) Evaluating the extent of wetting in hypersaline brines as a function of module design, operating parameters of the different units that compose the system (module, vacuum system, condenser, heat recovery system) and properties of the concentrate.

Collaborations with CNR (Italy), Aalborg University and with ESR5 and ESR9 will be key for the PhD and global project success. The technical feasibility of envisioned modules, the selection criteria of appropriate materials and properties for module will be assessed in relation with the company Polymem (France).

The ESR will attend: i) laboratory-based *Training through Research*; ii) advanced scientific and technical courses delivered at Network Meetings and EXBRINER Schools; iii) soft and transferable skill courses; iv) courses and events from the MEGEP Doctoral School; v) meetings from the research group and dept.

As a MSCA fellow, the ESR is also expected to contribute in the dissemination of the PhD Project's results in Conferences and publications in high rank international scientific journals.

ORGANISATION AND SUPERVISION

- The ESR will be recruited at the National Institute for Applied Science (INSA Toulouse; <http://www.insa-toulouse.fr>) from Toulouse Federal University (France). INSA is an international, pluridisciplinary, public engineering school, recognized for the excellence of its five-year education and international masters. INSA Toulouse provides a range of 8 engineering specializations, including chemical and environmental engineering. Its courses, linked to the latest scientific advances, are supported by the activity of leading-edge research laboratories, backed by large industrial groups.
- The main part of the PhD research (30 months) will be performed at Toulouse Biotechnology Institute (TBI), under the supervision of **Prof. Corinne Cabassud**. TBI (<http://www.toulouse-biotechnology-institute.fr>) is a public research laboratory jointly operated by INSA Toulouse, CNRS and INRAE. TBI has an international reputation for biological and sustainable processes, particularly applied to water treatment. The ESR will join the team "Separation, oxidation and hybrid processes for the Environment" (SOPHYE) in the research department "Sustainable Process Engineering", renowned notably on his sustainable approach of membrane processes for water.
- The PhD project includes two academic research stays of 2 months: at CNR (Italy), under the supervision of **Dr. Loredana De Bartolo**, and at Aalborg University (Denemark), under the supervision of **Prof. Cejna Anna Quist-Jensen**, and 2 months of **industrial secondment at the company Polymem** (near Toulouse, France).

REQUIREMENTS

- An outstanding M.Sc degree in Chemical Engineering, Process Engineering, Environmental Engineering or Energetic engineering
- Research experience on membrane processes and/or thermal and solar processes will be appreciated

- Skills and motivation on modelling and process optimization, as well as in experimentation
- Interest for technological developments and building prototypes
- An integrative and cooperative personality with excellent communication and social skills
- Fluency in English – written and oral
- Strict eligibility requirements for a Doctoral Candidate position in a MSCA-DN program include:
 - not have resided, worked or studied in France for more than 12 months in the 3 years prior to the start date of the PhD research. French citizen can apply if they respect the mobility requirement.
 - be in his early research career and not yet have been awarded a doctorate.

CONDITIONS OF EMPLOYMENT

Contract: Employment contract from INSA Toulouse for a full-time position of doctoral research engineer under public french law for 36 months, with a monthly salary.

Preferred starting date : 1 june 2023 (or 1 September 2023, for students graduated in 2023)

Salary : According to the rules of the MSCA Doctoral Networks, which equals in France a monthly gross salary of 2619 € (including social benefits and health insurance) + 600 €/month for mobility allowance. An additional family allowance is eligible when the researcher has a family upon recruitment.

APPLICATION PROCEDURE – DEAD LINE 24 MARCH 2023

To apply for the position, kindly provide **before the 24 MARCH 2023:**

- Signed **Letter of Motivation**, in English, covering the following aspects: reasons for applying to the PhD position, skills and abilities that make the applicant a good candidate, motivations to carry out research abroad, professional interests and expectations. Maximum one page
- Curriculum Vitae**, in English, detailing academic studies, professional career, publications and other relevant achievements;
- Copy of **academic qualification(s)/parchment(s)** – in original language and translated in English if the original language is not french – clearly stating the name of the University issuing the degree, the date of graduation, the final score; copies of **official transcripts** (mark sheets) of academic courses attended to obtain each degree (BSc, MSc or equivalent) - in original language and translated in English – and corresponding **Grade Point Average**; any other document considered useful (e.g. University Diploma Supplement) to assess the eligibility of the University Degree - in original language and translated in English
- Max two **Reference Letters**, in English, printed on letterhead and duly signed;
- Concise **recognition on the state-of-the-art** (3,000-4,000 characters), in English, on the topic addressed by the Individual Research Project;
- Copy of the first two and last two pages of the **Passport** or – for EU citizens - of the **Identity Card**;

Please send all the documents together in one PDF file, with file name « last_name_first name » by e-mail to Prof. **Corinne Cabassud** : cabassud@insa-toulouse.fr

INSA is an equal opportunity employer and values diversity. Our selection procedure follows the European Commission guideline for recruitment in the European Charter for Researchers and the European Code of Conduct for recruitment of researchers. More information on the EXBRINER web-site.