PhD position in chemical engineering

Development of a process for the valorization of Normandy's biomass from renewable energy.

LSPC E4704, Université et INSA de Rouen,
Avenue de l'Université - 76801 Saint-Étienne-du-Rouvray cedex, France

Duration: 3 years (Beginning between September and October 2020)

Salary: 1400 euros/month

Supervisor: Sébastien Leveneur (sebastien.leveneur@insa-rouen.fr)

Location: LSPC-INSA Rouen Normandie with a possibility to spend 6-12 months abroad.

Keywords: kinetic modeling, heterogeneous catalyst, biomass valorization.

Normandy region can be leader in the ecological transition. This region has several assets such as dynamic sectors in forest, farming, chemical and energy industries. Thanks to its geographic location, the development of wind energy will strongly increase. One of the main threat of wind or solar farm is their saturation leading to important energy loss [1]. To prevent such threat, one must store/transform these energies in hydrogen by using an electrolyzer [2]. Nevertheless, hydrogen can present some risk at different levels: supply system, storage or use [3-5]. Thus, there is a need to implement some safety barriers to decrease these risks.

To make sustainable the chemical industries, renewable biomass must be used. It is known that hydrogen is an important reactant for the valorization of biomass [5-8]. In this project, lignocellulosic biomass will be studied to avoid the dilemma food versus fuel.

The aim of this doctoral thesis is to develop a safe and sustainable process for the valorization of Normandy's lignocellulosic biomass by using wind hydrogen. It is important to say that this thesis will be in the framework of a Normandy's region project named ARBRE.

One of the first step is to fractionate the constituting element of this lingocellulosic biomass. The **Reductive Catalytic Fractionation (RCF)** process, using hydrogen, is a promising process because it preserves the lignin structure [9]. This new process is still studied at the laboratory scale [10-13]. This process has been studied since 2015, particularly by the research groups of Prof. Y. Román-Leshkov (MIT) [12] and of Prof. B. Sels (KU Leuven). This process combines a solvolytic extraction of lignin with a catalytic reduction by hydrogen favoring the lignin depolymerization into valuable aromatic platform molecules. Besides, the other constituting elements of this biomass, i.e., cellulose and hemicellulose are not damaged. To scale up this process, it is compulsory to develop thermodynamic and kinetic models, which is missing at the present moment. This process requires the use of heterogeneous catalyst, for that reason, a strong collaboration with **Prof. Françoise Maugé** (LCS Caen UMR 6506) will be developed.

This doctoral thesis will be done in the framework of the region project ARBRE, so the PhD students will be strongly supported.

The goals of this doctoral thesis are to:

-Select adequate heterogeneous catalysts;
-Perform some physicochemical and calorimetric measurement to develop a thermodynamic model.
-Make a thermal risk assessment of this process.
-Develop a kinetic model.

To ensure the success of the ARBRE project and doctoral thesis, the following international collaboration will be used:

-For the heterogeneous catalyst: Profs Murzin Murzin & Grenman (Åbo Akademi, Finland)
-For the development of the kinetic model: Prof. Igor Plazl (Ljubljana university, Slovenia)
-For the development of the thermodynamic model: Prof. Massimiliano Errico (University of Southern Denmark)
-For the thermal risk assessment: Prof. Valeria Casson-Moreno (Bologna university, Italy).

Requirements:

-Master thesis in chemical engineering;
-Experience in experimental work and solid background in analysis;
-Fluent in English;
-The PhD student might have the opportunity to make a scientific visit in one of the international laboratories mentioned above.

How to apply and get further information:

The candidates should send a detailed curriculum vitae, a motivation letter, transcript of record (Bachelor and Master), other valuable document (recommendation letter, awards,..). **These documents must be sent before the 2nd of June 2020 at sebastien.leveneur@insa-rouen.fr**

References:

1.Adam Vaughan, Use excess wind and solar power to produce hydrogen – report, The guardian, 2018.
2.Rapport IRENA Hydrogen from Renewable Power
3.M. Athar et al., Chem Eng Tech, (2019)
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5.Doctoral thesis of J. Keskiväli (2018) Catalytic valorization
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8.Y. Wang et al., Org Proc Res Dev 22 (2018) 1092-1100.
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10.D.J. Hayes et al., 2005. The Biofine process
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12.S. Bosch et al., Energy Environ Sci 8 (2015) 1748–63.
13.Anderson et al., ACS Sust Chem Eng 4 (2016) 6940–50.