CO2 re-uses technologies: a possible contributor to the environmental challenge

DUPONT Paul, LEONARD Grégoire,
Department of chemical engineering, University of Liège.
First author: Paul DUPONT, PhD student with <1 year research experience
Contact: g.leonard@uliege.be

In this communication, the activity related to CO_2 re-use at the University of Liège will be presented, with a particular focus on the power-to-fuel process.

The FRITCO_2T Platform was created in 2016 at the University of Liège and stands for a Federation of Researchers in Innovative Technologies for CO_2 Transformation. It gathers 4 research laboratories across 3 faculties that deal with many of the possible uses of CO_2 through, including direct physical use and chemical transformation. In addition, CO_2 capture processes are also studied, as well as the economic and environmental impacts of CO_2 re-use technologies (Life Cycle Assessment and techno-economic evaluation methodologies). Physical use activities study the direct use of supercritical CO_2 as a solvent for chemical or pharmaceutical applications, as well as its use as foaming agent for polymers. The research conducted in the chemical transformation field aims to create new ways to produce synthetic fuels (methanol, DME, or synthetic gasoline for instance), mono/polymers for the synthesis of CO_2-sourced plastics, as well as to study mineralization of CO_2 into and construction materials with improved properties.

Over the past 20 years, the members of the FRITCO_2T Platform have gathered over 12 M€ budget and purchased more than 3 M€ unique equipment. The platform has achieved about 45 research projects with currently 25 researchers active in it. Nevertheless, the platform is always looking for new projects and partnership to expand its activities and create new breakthroughs.

In this frame, our research focuses on the CO_2-sourced methanol synthesis that stands as a possible answer to growing environmental pressure to reduce global CO_2 emissions. Indeed, thanks to their high energy density, liquid fuels like methanol or DME offer an easy way to store and transport energy and thus to compensate for interseasonal fluctuations in the renewable energy production, so that they may be a key element to contribute to higher integration of renewable energies. Furthermore, while being a safer energy storage solution than hydrogen (less explosive, lower pressure), methanol is a very versatile precursor for the chemical industry as it can be used for many applications (olefins, formaldehyde, ethanol, …).

The current PhD thesis has started in February 2019. Its goal is to study the relevance of small-scale flexible units for CO_2-sourced methanol synthesis using the power-to-methanol technology. Modelling work as well as experimental approach will be conducted. So far, an Aspen Plus model of the power-to-fuel process has been developed and will contribute to an intensified and compact design of the methanol synthesis reactor. The construction of the set-up including electrolysis and methanol synthesis will begin in the coming months. In particular, the dynamic behaviour of the small-scale system will be studied in order to be able to respond to the intrinsic intermittency of renewable energy production.