CO_2 methanation combined with capture processes or applied to unseparated streams

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Abstract

Methane is one of the most widely used fuels, with an established distribution and conversion network worldwide. On the contrary, green hydrogen is trying to establish as a renewable energy vector, but its spread is inhibited by a lack of infrastructure. In order to sustain the energy transition, methane can be proposed as hydrogen vector thanks to the CO_2 methanation reaction. This is a well known process, but it presents criticalities from a thermodynamic point of view and for the strong exothermicity. Furthermore, its economic viability is not trivial.

In this work we will consider, both through process design and experimental approaches, the combination of different carbon capture options from point sources as preliminary step to collect and recover pure CO_2. The CO_2 stream will be allowed to a methanation plant fed with green hydrogen to achieve its transformation into methane with correct specifications for grid injection. Alternative options will be analysed to avoid the expensive step of CO_2 capture, by treating directly CO_2 containing unseparated gas streams. The specific example of the direct methanation of biogas will be explored. The thermal management of the reaction will be specifically considered, comparing different options with steam addition to leverage the reaction hot spots or using methane already present in biogas as thermal management aid.

Preliminary experimental results will be also considered for the methanation of CO_2 over different Ni-based catalysts, tested up to 30 bar and 450°C. Ni/CeO_2 revealed very promising as catalyst and will be tested in the next months in a pilot scale reactor.

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